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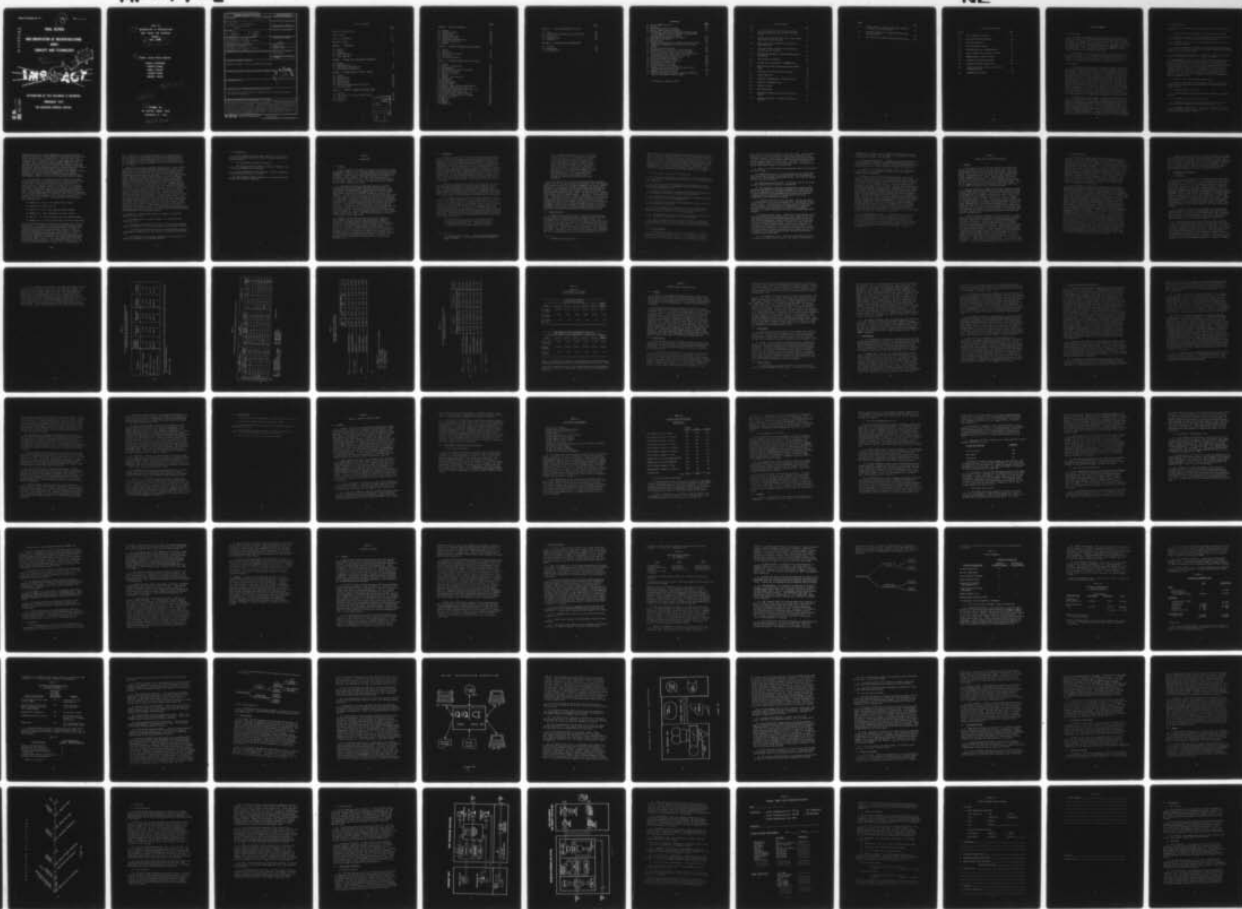
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ARMY CONCEPT AND TECHNOLOGY
(IMPACT).
9 FINAL REPORT.
Feb 75 - Feb 77

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TABLE OF CONTENTS

	<u>PAGE</u>
REPORT DOCUMENTATION PAGE	i
LIST OF TABLES	vi
LIST OF ILLUSTRATIONS	viii
EXECUTIVE SUMMARY	ix
CHAPTER 1 INTRODUCTION	
1-1 General	1
1-2 Problem	1
1-3 Background	2
1-4 Study Objectives	3
1-5 Study Approach	4
CHAPTER 2 CURRENT HQDA PUBLICATIONS OPERATIONS	
2-1 General	7
2-2 System Work Flow	8
2-3 Data Capture and Reduction	9
2-4 Conversion Considerations	11
CHAPTER 3 MICROPUBLISHING, STATE OF THE ART	
3-1 General	18
3-2 Federal Sector	18
3-3 State Sector	19
3-4 Private Sector	19
3-5 Manufacturers	20
3-6 Review of Reconnaissance Activities	22
3-7 Lessons Learned	28
CHAPTER 4 SURVEY OF POTENTIAL MICROFILM USERS	
4-1 General	29
4-2 Methodology - Trial and Revised Surveys	30
4-3 Findings	33
4-4 Discussion	40
4-5 Summary	42

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	<u>PAGE</u>
CHAPTER 5 PROTOTYPE SELECTION	
5-1 General	43
5-2 Selection Process	45
5-3 Final Design	56
5-4 Product Definition	62
5-5 Personnel/Training	63
5-6 Installation Considerations	64
5-7 Contract Processing	64
5-8 Summary	65
CHAPTER 6 PROTOTYPE MICROPUBLISHING OPERATIONS	
6-1 General	67
6-2 Operations	67
6-3 Data Capture Procedures	71
6-4 Observations	79
6-5 Cost Benefit Analysis	81
CHAPTER 7 MICROPUBLICATIONS USER FIELD TESTING	
7-1 Purpose	85
7-2 General - Introduction	85
7-3 Investigation	85
7-4 Preliminary Publications Selections	86
7-5 Test Site Selection	86
7-6 General - Test Plan	87
7-7 Synopsis	87
7-8 General - Test Execution	88
7-9 Preparation	88
7-10 Constraints	90
7-11 Test Plan Update	91
7-12 Event Sequence	92
7-13 General - Data Collection and Reduction	93
7-14 Baseline Reconnaissance (Phase I)	93
7-15 Fiche Design Factor Evaluation (Phase II)	93
7-16 Performance Study (Phase III)	94
7-17 Field Application Study (Phase IV)	95
7-18 General - Discussion of Test Findings	96
7-19 Phase I and Phase IV	96
7-20 Phase II	98
7-21 Phase III	98
7-22 Summary	99
7-23 Conclusions	100

	<u>PAGE</u>
CHAPTER 8 PROPOSED MICROPUBLISHING SYSTEM	
8-1 General	101
8-2 Proposed HQDA Micropublishing Installation	101
8-3 Cost Analysis	111
8-4 Implementation	111
8-5 Conversion	114
CHAPTER 9 CONCLUSIONS AND RECOMMENDATIONS	
9-1 General	117
9-2 Conclusions	117
9-3 Recommendations	119

APPENDICES *

	<u>PAGE</u>
A. Project IMPACT Directive	A-1
B. Glossary	B-1
C. HQDA Publishing System Workflow	C-1
D. Project Control Form ("Pink Sheet")	D-1
E. Cost Benefit Analysis On a Prototype Micropublishing System Compared to Similar Hard Copy Printing On the Present Publishing System. TAGCEN	E-1
F. Micrographics Reconnaissance Activities	F-1
G. Three Part Trial Survey	G-1
H. Revised Survey	H-1
I. Tabulation of Responses For Selected Trial Survey Items	I-1
J. Tabulation of Responses For Selected Revised Survey Items	J-1
K. New Start Exception Process	K-1
L. TAG Approval of In-House COM - Based Prototype	L-1
M. Request For Project IMPACT Field Test Assistance	M-1
N. Field Testing of Micropublications For Usability and Acceptability Within Brigade Level Functions	N-1
O. Field Test Program Microfiche Readers	O-1
P. Microfiche Reader Distribution	P-1
Q. Fiche Factors Evaluation (Phase II)	Q-1
R. Performance Test (Phase III)	R-1
S. Micropublications Usage Log	S-1
T. Project IMPACT User Debriefing	T-1
U. Tabulation of Responses For Selected Items On the Project IMPACT User Debriefing	U-1
V. Response Consistency Analysis	V-1
W. DACA-CAF Methodology Concurrence Report and IGAA-ECD Audit of Cost Benefit Analysis Report	W-1

* Contained in separate volume

LIST OF TABLES

TABLE		PAGE
2-1	Table of Statistical Data Related to Current Publishing Operations for the Data Collection Period	13
2-2	Statistical Data for the Most Active Publications Under Each Job Type Category	14
2-3	Mean Composition of Publication Job Orders by Publication Type	15
2-4	Mean Composition of Publication Job Orders by Job Type and Job Priority	16
2-5	Workload HQ Department of the Army Publications Directorate	17
4-1	Trial Survey Distribution	31
4-2	Revised Survey Distribution - FORSCOM Units	32
4-3	Reported High Usage Publications within FORSCOM Units	38
5-1	High Publications Requests (By Category)	46
5-2	System Comparison	49
5-3	Comparative Documentation - Production Cost	50
5-4	Comparative Equipment Costs	51
5-5	Production Steps	52
5-6	COM Installations	53
5-7	COM Based Micropublishing Systems Studied by IMPACT	54
5-8	Comparative Analysis - In-House vs Contract Services	54

TABLE		PAGE
6-1	Costing Analysis - Present Publishing, Expanded Prototype and Surveyed Systems	83
6-2	Personnel and Salaries - Expanded Prototype and Surveyed Systems	84
8-1	Yearly Costs for Proposed Micropublishing System	110

LIST OF ILLUSTRATIONS

FIGURE		PAGE
5-1	Print Preparation Subsystem	58
5-2	Microfilm Recording Subsystem	60
6-1	Prototype Milestones	68
6-2	Print Preparation Module	72
6-3	Film Recording and Processing Module	73
6-4	Project IMPACT Daily Production Account	75
6-5	IMPACT Equipment Failure Account	77
8-1	Proposed Micropublishing System	102
8-2	Comparison Between Document Costs	112
8-3	Total Savings Over Five Years for Various Proposed Systems	113
8-4	Implementation Schedule	115

EXECUTIVE SUMMARY

1. Introduction.

a. It should be recognized that this summary is a condensation of many of the thoughts and discoveries which are contained in the body of the report. The report itself is a compilation of much time and effort, and it too must condense, to some extent at least, a subject which affects every functional part, organizational element, and geographic location of the United States Army. The title of this study, Implementation of Micropublishing -- Army Concept and Technology (or IMPACT) is indicative of what the future holds for Army publications.

b. The US Army, as a result of this study, possesses the technology for micropublishing, and has developed concepts which incorporate and capture this technology. The need for and origins of this study surfaced in 1973, and what was once not possible a few short years ago has become an opportunity of great promise as the Army enters 1977.

2. Background.

a. Inflationary costs and periodic shortages of paper coupled with the costs associated with conventional printing and publications distribution methods brought forth a need to examine alternatives which might save dollars. Recognizing the immensity of the Department of the Army's publication system, considerable concern was generated at Headquarters, Department of the Army in the rising costs of not only paper and printing operations, but in increased budgetary requirements for composing and editing, processing, warehousing, inventory, requisitioning, distribution, shipping, mailing, and receipt of publications. Monetary considerations by themselves were not the only reasons for exploring alternatives to what has been accepted as conventional methods of furnishing printed publications. This study also addresses the question of whether or not increased levels of service can be provided the soldier by conversion to microform technology. In other words, would some medium other than paper be less expensive and, in the future, provide the Army with highly portable, easily updatable, maintenance-free publications?

b. The IMPACT Study formally began in February 1975 under the sponsorship of The Adjutant General, HQDA. The purpose of this study was to establish and develop a micropublishing prototype and develop an implementation plan which would permit the use of microform techniques as a substitute for paper publications. The study would take a look at the entire spectrum of publications users and DA publications, and from this would be developed possible alternatives incorporating microform usage in lieu of conventional hardcopy. This study assumes that many publications will remain in hardcopy even though certain user groups throughout the Army might be able to use these same publications in a non-paper form.

3. Study Objectives.

- a. Develop a micropublishing system proposal for the Department of the Army.
- b. Analyze the current Department of the Army publishing system.
- c. Formulate alternatives of representative micropublishing systems for a Department of the Army prototype publishing operation.
- d. Determine user requirements and prototype constraints for selection of an optimal system.
- e. Design and evaluate a micropublishing prototype that incorporates all aspects of a micropublishing system which might reasonably be expected to exist in a real life environment.
- f. Design a field test which will measure the usability and acceptability of micropublished documents in a field environment.

4. Study Methodology. The project was divided into two major phases so that an accurate assessment of micropublishing could be addressed in terms of its applicability to HQDA publications. Each phase was subdivided into tracks and in some cases, further separated into sub-tracks. The study team's composition was interdisciplinary and consisted of management analysts, micrographics technologists, operations research analysts, computer specialists, publications editors, and personnel psychologists. The entire project covers a twenty-one month period, with the initiation of Phase I in February 1975 until the completion of Phase II in October 1976.

a. Phase I - Data Acquisition and Analysis Phase.

(1) Reconnaissance Track - An exploration and review of existing publications and micropublications operations in the government and private sectors.

(a) HQDA Publications Sub-Track.

(b) DA/DOD/Government Printing Office/Joint Committee on Printing Sub-Track.

(c) Federal/State/Private Sector Sub-Track.

(2) Economic Analysis Track - The collection of current publications costs versus a comparison of known micropublishing costs.

(3) Equipment - Systems Track - A series of extensive evaluations of vendor micropublishing equipment alternatives in anticipation of the prototype design undertaken in Phase II.

(4) User-Distribution Track - Two separate worldwide surveys were conducted to evaluate user and potential user reaction to micropublications. The first survey polled 14 Major Command Headquarters using three separate questionnaires with a total mail-out of 3,600. The second survey, a refinement of the first, was dispatched to 12 separate brigade and division size units as well as the 14 MACOMs who were again surveyed a second time. The mail-out for the second survey totaled 8,290 questionnaires.

b. Phase II - Prototype Operation Phase.

(1) Economic Analysis Track - Based on the creation of the IMPACT micropublishing system prototype, empirical data was generated which could now be compared with current operations' costs. A major product of this portion of the study is the cost benefit analysis which outline the comparative costs.

(2) Prototype Track - The actual selection and design of the IMPACT prototype is described and documented.

(3) User-Distribution Track - As a follow on to the worldwide user and potential user surveys conducted in Phase I, a user field test was constructed and actually administered to a FORSCOM brigade to determine the usability and acceptability of micropublications in a tactical environment.

5. Description of Micropublishing.

a. State-of-the-Art. Simply defined, micropublishing is the issuance (publication) of new information in multiple copy microform. Microform is a generic term for any form, either film or paper, containing microimages. The most commonly accepted microform is microfilm. The IMPACT project homes-in on a particular form of microfilm known as microfiche. A microfiche is a sheet of approximately 4 inch by 6 inch microfilm containing multiple microimages in a grid pattern. This study analyzes conventional methods of microfilming and computer output microfilm (COM). Current limitations to both processes are quickly uncovered through a decision diagram process which lays out the inadequacies of today's methods. Step-and-repeat and COM methods are examined by physical characteristics, in terms of their relative costs, as well as each operational step involved in the respective process. Through detailed analysis a state-of-the-art COM system is designed for in-house operation by the study group.

b. The Prototype. The three main components or functional subsystems of print preparation, film recording and film development/duplication were combined in such a way that this system became the first of its kind to handle test material and illustrations through

COM so that a publication could be produced entirely on microfiche. The front-end of the IMPACT micropublishing system was a computer based print preparation system which converted author input into machine readable form. The output of this system provided the input to the second component, the COM recorder. The second subsystem, the COM recorder, accepted text and produced true printing capabilities in every sense of the word, and it also proved that it was capable of merging illustrations (line drawings, half tones and photographs) with textual information. The film processing or film development subsystem was not included in the in-house operation. Due to the short life span (1 April through 30 September 1976) of the prototype it did not warrant the set-up expense to handle water supplies, waste drainage and venting of noxious gases. A private contractor provided twenty-four hour turnaround for developing and duplication services. The 6 month operation of the prototype had as its objectives: (1) obtain hands-on experience (2) collection of detailed cost data, (3) microform format experimentation, (4) determination of most effective equipment utilization, (5) development of maximum thruput methods, and (6) determination of personnel requirements. Chapter 5 provides a detailed accounting of the methods and procedures which produced the first micropublishing prototype. Chapter 6 documents the tri-modular systems approach and explains in narrative and graphic fashion both the characteristics of the system and the nature of its operation. Significant aspects of the cost benefit analysis are summarized so that the present publishing system can be compared to potential micropublishing systems. Analysis of data gathered during prototype operation made it possible to defined the parameters and coefficients of a mathematical model which is described in the cost benefit analysis. The model was then extrapolated to define an optimum and a nonoptimum micropublishing system. These were expanded versions of the prototype. The mathematical model is also used to analyze another possible configuration referred to as the surveyed system. The expanded prototype and the surveyed system were identical in all areas except for the print preparation module. Detailed analysis reveals that the limiting thruput factor in all proposed systems is the front-end or print preparation subsystem.

6. Description of Field Surveys and the User Field Test.

a. Field Surveys. A successful Army micropublishing system should not be designed in vacuo but should take into consideration user requirements, preferences and constraints. The IMPACT Study Group constructed two separate attitude and inventory questionnaires which would serve as input to answering the what, when, and how to micropublish. A survey was needed that was appropriate for personnel of varied backgrounds. To assure maximum clarity and completeness, a three part trial survey was developed for management personnel, microfilm users, and potential microfilm users. In addition to

presenting data which provided information to the prototype design group, the trial survey clearly demonstrated the field use of microfiche and the recognition of its potential uses. The trial survey also served as a check on the revised survey. The second version included 12 FORSCOM units in addition to the 14 original MACOMs which were surveyed. These surveys served three important purposes. First, the data provided direct input to the selection of the hardware prototype. They greatly aided in answering questions on publications usage, the user environment, and hardcopy to microfiche conversion procedures. Secondly, a great deal of descriptive information was uncovered on user needs and the user environment of FORSCOM units and the MACOM headquarters. Finally, the surveys yielded inventory data on microfiche viewers currently in use as well as projected needs for viewers.

b. User Field Test. Although the data derived from the worldwide surveys expressed favorable opinions about the current and future uses of microfiche, a publications micropublishing system would be of limited value if its products could not or would not be utilized by Army field units. Through a series of staff visits to six representative CONUS installations, interviews were conducted with personnel in combat, combat support and combat service support organizations in order to obtain information about publication usage and field reactions to the micropublishing concept. In addition, each of these installations or major units on the installation were surveyed to determine its suitability as to a test site. The installations visited and major units contacted were:

Ft. Huachuca, Az - HQ U.S. Army Communications Command

Ft. Meade, MD - HQ First U.S. Army

Ft. Belvoir, VA - HQ U.S. Army Computer Systems Command

Ft. Campbell, KY - 101st Airborne Division (Air Assault)

Ft. Knox, KY - U.S. Army Armor Center and 194th Armored Brigade

Ft. Benning, GA - U.S. Army Infantry Center and 197th Infantry Bde.

The 197th Infantry Brigade was selected by HQ FORSCOM as the user test organization. A test plan titled "Field Testing of Micropublications for Usability and Acceptability within Brigade Level functions" was constructed consisting of four major phases. They were: Phase I - Baseline reconnaissance (to gather all necessary data on a brigade's operations, structure and publications usage); Phase II - Fiche Design Factor Evaluation (to determine how design of microfiche influences usage); Phase III - Performance Study (controlled observations of microfiche usage); Phase IV - Field Application Study (the actual continued usage of microfiche in lieu of hardcopy publications). The test was carried out during July - October 1976. A clear majority

of the soldiers who used micropublications were of the opinion that they are superior to paper copy. This feeling was emphasized when at the conclusion of testing one third of the users requested that the viewer equipment and test microfiche be left for combined use despite the knowledge that changes to documents could not be supported beyond the test project.

7. Proposed Micropublishing System for Implementation. Based on final evaluations of the prototype micropublishing operations and its cost benefit analysis with supportive evidence from reconnaissance actions, and personnel surveys/field testing, an optimum full scale DA micropublishing installation has been developed. This system design includes a full complement of equipment specifications, personnel, staffing, annual supply requirements and necessary contractual service support. A year's operating costs covering personnel, overhead, maintenance, supplies and duplication services amount to \$2,136,781/year of which over half is for contractual duplication services. Equipment purchase and installation costs, not included in the above amount to \$975,022 and \$23,185. TDY is estimated at \$25,000/year. The defined installation is a full scale operating installation with expertise at all levels of the technology from manager to clerk typist. The detailed system has capacity to convert 4,100 publications to microfiche and produce the necessary duplicates for distribution. The anticipated five-year savings of conversion from applicable hardcopy documents to microfiche is in excess of \$9.5 million over the first five year operation. The system development methodology permits a similar evaluation of degraded systems which employ fewer operating personnel and text entry devices. These alternative choices have resultant reductions in costs - but lower production and cost savings. An implementation schedule (of 52 weeks) will put this system fully on-line. The proposed implementation schedule defines and time phases significant milestones which were developed during the implementation of the project prototype.

8. Conclusions. The following conclusions summarize the findings supported by this study:

- a. Micropublishing is a feasible adjunct to a DA conventional publishing system.
- b. COM-based micropublishing is the current state of the technology and this condition will not basically change in the foreseeable future.
- c. A tri-modular COM-based production system when operated in-house, is economically advantageous to the conversion of appropriate DA publications.
- d. The introduction of microfiche publications at all levels will present no inordinate user acceptance problems.

9. Recommendations.

a. That a detailed follow-on study (IMPACT II) be initiated to establish the elements required to affect an optimal conversion to micropublications.

b. That the IMPACT Final Report be approved.

c. Upon the revalidation of IMPACT's findings by IMPACT II the following recommendations be considered:

(1) That a COM-based, in-house operated, contractor supported micropublishing installation be created.

(2) That micropublishing be organized as a division of the TAG Publications Directorate (DAAG-PAZ).

CHAPTER 1

INTRODUCTION

1-1. General.

a. The Department of the Army (DA) publications system is immense and extremely complex. The continuing explosion in information is felt throughout the Army with ever increasing demands for more published information to support the continuing sophistication of its people, its procedures, and its hardware. The Army's many diverse missions - research and development, medical, legal, training, education, morale and ultimately, combat - all require information and derive support from the Army's publications system.

b. At the present time most HQDA publications are produced in hardcopy, that is, some form of printing applied to paper. For several years government agencies and private industry have turned increasingly to other forms of non-paper media as a means to disseminate written and graphic information economically, quickly, and compactly. If the current level of service provided publications users is to be increased or enhanced through an exploration of new methods and technologies, then an investigation into the world of micrographics is a necessity. Micrographics, the industry which reduces any form of information to a microform medium, provided the non-paper outlet for this study. Although the microform that was chosen for study and analysis, 24:1 microfiche, will be spelled out in more detail later in this report, suffice it to say for the present that microform is a generic term used for any form containing images too small to be read with the unaided eye. Under the guidance and direction of The Adjutant General, United States Army, a study plan was prepared so that this investigation could be carried out.

1-2. Problem. The inflationary costs and periodic shortages of paper coupled with the costs of preparing, printing, updating, storing and distributing hardcopy Army publications in their conventional paper form manifested a need to examine other technologies which could have inherent cost reductions in these areas. As a developing technology, micropublishing can reduce the above costs, as well as increase the timeliness and reliability of the information provided the user. This report will examine the development of a micropublishing system which reduces publications costs and increases user accessibility to DA publications. Further, the report will present initial implementation recommendations for conversion to micropublishing.

1-3. Background.

a. During the years of 1973 and 1974 it became increasingly apparent that paper and associated printing costs were continuing to spiral upwards. Recognizing the immensity of the Department of the Army's publication system, considerable interest and concern was generated at Headquarters, Department of the Army (HQDA) in the rising costs of not only paper and printing operations but in the increased budgetary requirements for composing and editing, processing, warehousing, inventory, requisitioning, distribution, shipping, mailing and receipt of publications. Departmental printing costs alone had risen to over 40 million dollars in FY 74. Past and possibly future scarcities of paper, rising mailing costs, and the associated problems of filing, storing and updating paper publications dictated a real need to examine some other way, or at least a companion means, of furnishing the printed word within the Army.

b. Monetary considerations by themselves were not the only reasons for investigating alternatives to what has been accepted as the conventional means of furnishing printed publications throughout the Army. The exploration would also consider if an increased level of service could be provided to the soldier and his commander. What other medium might be less expensive and, in future years, provide the soldier with highly portable, easily updatable, maintenance-free publications?

c. From February through November 1974, HQDA conducted a study in response to a need to document the current publications system in order to provide an adequate data base for system evaluation and possible improvement. This study known as the STARPUBS Study, or Study of the Army Publications System, considered factors such as paper shortages and increased printing costs.¹ The thrust of the STARPUBS Study did not consider changes in publication media from paper to non-paper forms, but it did provide data and valuable insights into current HQDA publications operations. The following statement from STARPUBS supports the contention of this study that portable and maintenance free publications will serve users at all levels.

"The publications system exists to provide publications to the users, and this should be the goal toward which all operators and managers work. In practice, however, the current system has grown to support the proponents

1. The Adjutant General's Center. Study of the Army Publications System (STARPUBS). US Department of the Army. Washington: 1974.

and the managers more than the users. The existing concept of pinpoint distribution direct to company/battery/troop level is an excellent one. But as it has been implemented, the distribution system has serious defects -- primarily caused by the large and confusing workload it imposes on administrative personnel in the user unit. Typically, the system relies on a specialist forth-class company clerk with a high school education, limited Army experience, and little or no training in publications duties. This inexperienced clerk has 266 other major administrative tasks to perform and insufficient time to devote to any of them."²

d. Since October 1973 the US Army Training and Doctrine Command (TRADOC) has been developing concepts and procedures that, when approved as Army doctrine, would relieve company commanders and company clerks of administrative and logistics burdens. Realignment of these logistics functions is being studied and realignment of personnel functions are currently being implemented under a concept called Consolidation of Administration at Battalion Level (CABL). The CABL study will recommend consolidation of three company functions - personnel, food service, and supply - and centralization of a fourth - maintenance - at the battalion level. Centralization in this context means a grouping of functions at a higher level while maintaining unit integrity and identification. Consolidation of these other company functions will be discussed further in Chapter 7 under the user testing of micropublications in a field environment. Publications pinpoint distribution concepts coupled with micropublishing technology can provide greater efficiency and ease of operations as battalion consolidations of company functions occur.

1-4. Study Objectives.

a. Recognizing the problems facing the Army Publications System and the advance of microform technology, a project directive and plan was prepared under the sponsorship of The Adjutant General. On 6 February 1975, the project directive was signed by The Adjutant General of the US Army acting in his capacity as the Commanding General of The Adjutant General Center (TAGCEN). The subject of the project directive (see Appendix A), "Implementation of Micro-Publishing, Army Concept and Technology", gave rise to the "IMPACT" acronym which is used throughout this report. The purpose of the study was the establishment and development of a micropublishing prototype and an implementation plan which

2. STARPUBS Study, Op cit page 1.

would permit the use of microform techniques in the formatting, printing, and distribution of HQDA publications. Due to the broad range of publications, proponents, and users, the stated objectives of the study do not infer or intend that microform would replace hardcopy publications in toto. The study would take a broad look at the entire spectrum of users and DA publications, and from this would be developed possible alternatives for microform usage in lieu of conventional hardcopy. Furthermore, it was presumed that many publications would remain in hardcopy even though certain user groups might use these same publications in a non-paper form.

b. The specific objectives of the study were:

(1) Develop a micropublishing system proposal for the Department of the Army to include implementation plans for conversion to micropublishing where applicable.

(2) Analyze the current Department of the Army publishing system utilizing data gathered by the STARPUBS Project to establish the scope of the micropublishing application.

(3) Formulate alternatives of representative micropublishing systems for a Department of the Army prototype publishing operation.

(4) Investigate and document current problems in micropublishing and the impact they will have on DA implementation.

(5) Determine user requirements and proponent constraints for selection of an optimal system design.

(6) Design and evaluate a prototype that will incorporate those aspects of a micropublishing system as might be deemed reasonable to exist on a large scale basis in a real life environment.

(7) Design a field test which will measure the usability and acceptability of micropublished documents in a field environment.

(8) Draft recommendations for subsequent inclusion in appropriate Army Regulations which will provide additional controls for micropublishing and text processing activities applicable to HQDA publications operations.

1-5. The Study Approach.

a. The study project was divided into two major phases so that an accurate assessment of micropublishing could be addressed in terms of its applicability to DA publications. Phase I was designated as the Data Acquisition and Analysis Phase, and Phase II, the Prototype Operations

Phase, followed closely on the heels of the first phase. A more detailed description of these major portions of the study is elaborated in the following paragraphs. Each phase was further subdivided into sub-phases or tracks so that essential elements of analysis and investigation could be more properly organized and controlled. The entire study covers a twenty-one month effort, with the initiation of Phase I in February 1975 and the completion of Phase II in October 1976.

b. Phase I - The Data Acquisition and Analysis Phase was divided into four major tracks:

(1) Reconnaissance Track. As its name implies, the reconnaissance track explored and reviewed existing publications and micropublishing operations in the government and private sectors. This track was further divided into three sub-tracks:

(a) HQDA Publications Sub-Track. An evaluation and review of the on-going DA publications system and its operations.

(b) The Department of the Army (DA)/Department of Defense (DOD)/Government Printing Office (GPO)/Joint Committee on Printing (JCP) sub-track. An assessment of micropublishing interest and activity within the Armed services and the Government Printing Office was undertaken in addition to the establishment of communications with the US Congressional Joint Committee on Printing.

(c) Federal/State/Private Sector Sub-Track. Besides the exploration of DOD activity, research was carried-out in the remainder of the federal sector. A combination of literature search and study team contact with various state governments was accomplished in addition to assistance from such organizations as the National Micrographics Association, in order to determine the extent of micropublishing within industry.

(2) Economic Analysis Track. In addition to considerations of the increased feasibility of micropublishing, a major portion of the study was devoted to producing cost/benefit comparisons using recorded cost data obtained from present DA publications operations versus empirical data from micropublishing operations. Relative cost and volume relationships of current methods provided a baseline for examination of micropublishing alternatives to determine the relative benefit(s) of: micropublishing a manuscript versus printing that manuscript; reproducing a given number of copies per manuscript by micropublishing in lieu of operating conventional printing presses; and analyzing potential user/distribution requirements.

(3) Equipment-Systems Track. The Study Group found it necessary to contact many vendors in the industry; run extensive evaluations of

micropublishing equipment; select equipment alternatives, and accompanying cost and benefit data; and make the final equipment selection in anticipation of Phase II of the Study.

(4) User-Distribution Track. Through the use of world-wide surveys, user requirements, constraints, attitudes and recommendations were collected and used in order to ensure the validity and usability of the final products which could be generated during prototype operation.

c. Phase II - The Prototype Operations Phase. The second phase was also divided into sub-phases or tracks so that each necessary element could be controlled.

(1) Economic Analysis Track and Prototype Track. The primary purpose of these two tracks was to generate empirical data on costs and publication throughput-time as it contrasted with hardcopy operations. The selection of the prototype which is described in detail in Chapter 5 was based on five essential criteria: First, the prototype must contain "current state-of-the-art" subsystems which have proven workable in either the federal or private sectors. Although the overall project may ultimately provide a springboard for selected research and development activity, the "off the shelf" approach meant that this phase of the project could maintain contact with what is possible and realistic today. Secondly, the prototype had to be modular in its performance, so that any subsystem could be changed or modified without affecting the overall system. Next, modularity guaranteed that subsystem data output could be separated and analyzed independently. A fourth criterion was interface compatibility with other devices which could be added or deleted from the system as a whole. An example of this requirement is the addition or removal as needed, of optical scanning equipment. Finally, the prototype must be provided with options that would allow for microform or hardcopy output. A description of the functional elements of the system is contained in Chapter 5.

(2) User/Distribution Track. As a necessary follow-on to the world-wide attitude surveys carried on in Phase I of the study, a usability and acceptability testing program was designed to establish the areas and levels of usage for the possible conversion of HQDA publications from hardcopy to microform. Microfilm user response was needed in the real world operational environment. The user test of a tactical FORSCOM brigade described in Chapter 7 did much to accomplish this.

CHAPTER 2

CURRENT HQDA PUBLICATIONS OPERATION

2-1. General.

a. To develop the cost benefit data required for evaluating an Army micropublishing system, it was necessary to explore the cost-determining elements of current hardcopy publications. Many system related factors contribute to making this cost analysis unique and complex. Consideration must first be given to what segment of the document preparation chain to study. Where possible, the chosen segment should have parallels in a micropublishing prototype system. In searching for these parallels, the most accurate and complete cost data for the current system was found in one particular segment. This was the segment beginning with the submission of camera ready copy to the printer and ending with the finished product(s).

b. Once the appropriate segment of the current publication system was determined, other variables surfaced which could affect the final figures on the printer's invoice. In some cases publication printing was performed at the Government Printing Office, and in others it was contracted to printers operating in the private sector. At times, a publication was printed in parts, each part as a separate printing job, making it difficult to obtain a consolidated invoice on the costs of the total document. The charges for different kinds of textual and graphic material varied across the printing marketplace. Other cost complexities could arise if the various branches of the Armed Services shared the cost of printing a single publication. Printing costs were also dependent on the quantity of work submitted, the requested completion dates, and the degree of preparation required of the submitted material for publication.

c. A cross examination of printer's invoices on file, in conjunction with a file search of publication preparation records, revealed additional criteria to be considered in the cost determination of a particular printing job. Printing jobs requested on an expedite priority basis generally involved different charges from printing requests with routine production schedules. Routine printing jobs are those which take an average of 3-4 weeks to initiate, whereas expedite jobs require immediate action. Other variations in charges depended on whether the job request involved the printing of a new publication, or the printing of change inserts to an existing publication, or a complete reprint of a publication with change inserts. In order to establish the complexities of cost determination for any particular printing job, a data collection scheme was needed which could pin down "per-page" cost under these varied circumstances. To supply this need, the data collection instrument described in paragraph 2-3 was designed.

2-2. System Work Flow.

a. Based on the STARPUBS (Study of the Army Publication System) findings, a HQDA publication workflow chart is displayed in Appendix C. An examination of this flow chart reveals that three main functional elements are discernible. These elements are the Publishing, Procurement and Distribution Management divisions of the Publications Directorate, The Adjutant General Center (TAGCEN). The overall responsibility of the Publishing Division is in the actual manuscript editing process. Activities in this area include the editing of proponent text, associated artwork, and original forms to conform to current Army standards. The Publishing Division's responsibility lies in performing the necessary manuscript preparations to meet printers' layout requirements. This division's activities include the determination of number of pages, type size, and style of binding, etc. Distribution Management, the smallest division, has the overall responsibility for determining publication distribution requirements.

b. The publication processing chain begins with the proponent. Regulations exist which instruct the proponent in the proper method of publication preparation. Adherence to these preparation instructions serves as the early stage of the text editing process. The publication is submitted directly to the Army's Publications Directorate (TAGCEN) and enters the Directorate through the Publishing Division. A jacket (folder) and control card are prepared which places the publication into the processing stream. Editing is completed in coordination with the proponent. If the publication contains artwork or original forms, it will be routed to that part of the Publishing Division which reviews these items for eventual publication. When a publication request contains text only, with no new artwork or forms, it will bypass this activity and enter the Distribution Management Division for a determination of distribution requirements. After actions by the Distribution Management Division are completed, the publication enters the print-preparation process in the Procurement Division. In a special area of the Publishing Division any new artwork and forms are prepared for printing. This process involves editing, page numbering, and preparation of the job file jacket. Once the artwork is completed, publications with artwork will then join the "text-only" publications in the print-preparation process. As the publications enter the Procurement Division, necessary control forms and jackets are prepared in readiness for submission to the printer(s). Division printing-assistants review the publications for proper adherence to the printers' requirements. A "print-program" informs the printer about the number of pages, page size, publication number, and binding type for the manuscript. Requisition numbers are then assigned to the printing job.

c. Before the manuscript can be sent out for printing it is routed back to the Military District of Washington Finance and Accounting Office to have the necessary accounting information added to the job jacket. The job jacket with appropriate forms is then filed within the Procurement Division. Copies of other forms are sent to the proponents. The manuscript, with the necessary printing forms is now forwarded to the Government Printing Office (GPO) where the decision will be made to print in-house or contract the job to private sector printers.

2-3. Data Capture and Reduction.

a. Methodology.

(1) In order to determine cost data regarding various types and situations of publications processing, a special data form was developed (see Appendix D). This form was completed in conjunction with each publication printing job as it was processed through the Publications Directorate. The scope of this data collection effort included all types of processing jobs from January through April 1975. With this data form, information was obtained on the publication number, its proponent, and type of publication. Respondents also indicated whether the printing job was a new publication, a change to an existing publication, or a complete reprint of the entire publication. A block was provided to designate the printing job as routine or expedite. Other blocks were provided for entering requisition number, invoice number, and estimated cost. To characterize the printing job even further, information was requested on number of pages, number of copies, total number of changes and the sequence number of the current change being processed.

(2) The data collection form was designed to be keypunched for later data reduction. Blocks were provided for the requested information in order to aid the user in the correct recording of the data. The data collection form was printed on pink paper. This contrasting color was chosen to make it easier to locate the form among other papers normally found in a publication processor's work area.

(3) During the collection of the "pink sheet" data, some early problems were encountered and resolved. In certain cases there was a time lag of three to six months between the initiation of a printing requisition and the ordering of the job. In these cases it was not possible to complete the entire pink sheet. Cost data, invoice number, and requisition number could not be obtained until job completion. This problem was resolved by a manual "search and match" process, using the pink sheets and the files of printer's invoices. In a number of cases, even when the invoices were obtained, it was difficult to determine if the invoices represented partial, estimated, or complete

cost data. During the test period, the pink sheet form provided much information on each publication job-order. However, some supplemental information on these same job orders was needed. A manual search of publication processing files revealed needed information on the textual and graphic composition of the job-order samples. Retrieved information included numbers of typeset manuscripts, camera-ready masters, negative pictures, halftone drawings, linecut figures and foldouts (pasters). Key punching of the pink sheet form included this supplementary data as a second case-card for each sample. Thus, each job-order sample contained two punch cards. During the test period, 4,716 requisition order pink sheets were accumulated. Of this number, 2,387 were eventually matched with respective cost data. These 2,387 sheets became the basic sample for data analysis.

b. ADP Processing and Analysis.

(1) The subprograms of the Statistical Package for the Social Sciences (SPSS) were used to reduce and analyze the data. Summary data is presented in Tables 2-1 to 2-4. Additional detailed data is presented on pages E2-E4 of Appendix E, and in Inclosure 2 of Appendix E. For reference, Table 2-5 presents historical data related to the Publication Directorate's workload, FY 70-74.

(2) In examining Tables 2-1 to 2-4 certain significant findings become apparent. From Table 2-1, it can be determined that the largest volume of publication jobs involved reprints, while the least frequent jobs were original publication requests. Original or new publications contained an average of 75 pages. Changes contained an average of 29 pages, while reprints averaged 101 pages. These findings aid in identifying the sources of the greatest processing workload. Examining Table 2-2, the sources of this current workload are further refined. In the original-document preparation category, and in the reprint category, Technical Manuals (TMs) are the most active publications. Next to Tables of Organization and Equipment (TO4Es), TMs also appear as the most often changed type of publication. Tables 2-3 to 2-4 indicate the average composition of publication job-orders by type of publications and job action. This information was available for 1,009 of the original 2,387 data cases. Portions of Tables 2-3 and 2-4 present the extent of publication text and illustrations that were and were not proponent-submitted in camera-ready or negative form. For example, in Table 2-3, TMs are shown to involve the processing of 2.51 linecuts per average document. Other linecuts, graphics and text that were completely proponent-prepared would be represented in the 43.09 and 49.35 figures for average number of TM negatives and camera-ready masters. Unprepared or partially prepared illustrations will demand greater processing attention. Thus, illustration (graphic) content is considered to be a significant contributing factor to the average invoice cost of publication job-orders. This premise should be considered in the interpretation of Table 2-1.

2-4. Conversion Considerations.

a. In summary, a conversion from conventional publishing to micro-publishing must consider all the statistical information related to current hardcopy production. Any degree of microform conversion will involve many procedural changes within the current processing chain. The conversion could reduce many of the required administrative forms and procedures. Throughout a transition period, extensive personnel training will be necessary to aid the current staff in understanding and dealing with micropublications.

b. An early fundamental consideration must involve the selection of applicable publications for conversion. The decision must analyze information on all aspects of a publication, its size, type, and distribution. Illustration content can involve extensive additional processing time and resources. After reviewing the total present data, it was determined that technical publications contain the greatest amount of this graphic material, whereas administrative publications (AR types) would contain the least. Thus, from the graphics standpoint, technical publications can be more costly to convert.

c. The present publishing operations serve a variety of proponents and these proponents in turn, serve users in many environments. This premise points out that any chosen style of microform must be suitable for a variety of operational needs. To cover this range of needs, consideration was given to the available microform options.

d. Coordinating the findings of this chapter, potential-user surveys (Chapter 4), the user field test (Chapter 7) and other known data on current distribution of viewers, certain microform options appear more favorable for Army micropublications. For most users, microfiche was determined to be the most efficient type of microfilm. However, for a significant number of Army operations already using microfiche successfully, this determination has already been established. The 4 x 6 inch microfiche contains the qualities of minimum storage requirements and easier image retrieval (look-up time). These features are applicable to the greatest number of users. Cartridges and roll film do not fare as well on these characteristics. In considering a reduction ratio that would be appropriate for most users, 24:1 best fills this need. The 24:1 ratio allows maximum microfiche reading clarity, and is the limit for acceptable quality in "blowing-back" documents for reproduction which include illustrations. In addition, 24:1 being less vulnerable to scratch related obliterations than the higher reductions, permits it to be durable under a greater variety of operational settings.

e. Other conversion considerations will include the findings related to the overall composition of the publication processing workload. For the data collection period, reprint and change job-orders outnumbered new publication job orders almost ten to one. These determinations suggest that a micropublishing system should be prepared for rapid turnaround of many change and reprint requests. Responsiveness will be needed to meet publication copy requests which average from 2,000 to 5,000 copies per order. A DA micropublishing system will also be required to fill approximately one third of its publication job-orders on an expedite basis. Such considerations are vital to the selection of hardware, systems, and personnel to effectively meet these basic requirements.

TABLE 2-1

TABLE OF STATISTICAL DATA RELATED TO CURRENT PUBLISHING
OPERATIONS FOR THE DATA COLLECTION PERIOD*

STATISTIC	ORIGINAL DOCUMENT PRODUCTION	PUBLICATION CHANGES	PUBLICATION REPRINTS	ROUTINE JOB ORDERS	EXPEDITE JOB ORDERS
# Job Orders in Category	256	1,195	1,249	1,697	690
Mean # Pages	75.24	28.56	100.49	86.84	34.40
Mean # Requested Copies	5236.97	3430.94	1987.07	2392.36	4047.67
Mean Invoice Cost	\$1338.46	\$542.07	\$1061.10	\$1002.86	\$645.46
% of Total Job Requests	11	37	52	71	29

* These statistical averages are adjusted to remove abnormally extreme figures that would misrepresent the total publication workload.

Sample Size = 2,387

TABLE 2-2
STATISTICAL DATA FOR THE MOST ACTIVE PUBLICATIONS UNDER EACH JOB TYPE CATEGORY

ORIGINAL DOCUMENT PRODUCTION N=256						PUBLICATION CHANGES N=882						PUBLICATION REPRINTS N=1249					
PUB TYPE	# CASES	% OF ALL PUBLS SUBMITTED	MEAN # REQUESTED COPIES	MEAN # PAGES	MEAN # REQUESTED COPIES	PUB TYPE	# CASES	% OF ALL PUBLS SUBMITTED	MEAN # REQUESTED COPIES	MEAN # PAGES	MEAN # REQUESTED COPIES	PUB TYPE	# CASES	% OF ALL PUBLS SUBMITTED	MEAN # REQUESTED COPIES	MEAN # PAGES	MEAN # REQUESTED COPIES
TM	72	28	1,648	112	1,563	TO&E	392	44	16	1,563	1,297	TM	783	63	122	1,297	1,297
TB	31	12	3,061	43	2,450	TM	300	34	35	2,450	4,334	AR	104	8	47	4,334	4,334
TO&E	18	3	1,344	24	6,825	TB	78	9	28	6,825	295	TO&E	75	6	30	295	295
DA CIR	10	2	15,720	19	17,172	AR	34	4	34	17,172	8,229	FM	56	4	110	8,229	8,229
DA PAM	9	2	9,036	68	3,356	SC	18	2	14	3,356	1,099	TB	32	3	54	1,099	1,099
SB	7	3	10,311	36	7,873	DA CIR	12	1	16	7,873	6,492	DA PAM	31	2	156	6,492	6,492
AR	7	3	13,629	22	11,663	SB	8	1	89	11,663	1,869	LO	21	2	26	1,869	1,869
SC	6	2	3,000	13	7,267	FM	6	.7	56	7,267	480	SC	20	2	162	480	480

KEY:

TM = Technical Manual
 TB = Technical Bulletin
 TO&E = Table of Organization & Equipment
 DA Cir = Department of the Army Circular
 DA Pam = Department of the Army Pamphlet

SB = Supply Bulletin
 AR = Army Regulation
 LO = Lubrication Orders
 SC = Supply Catalog
 FM = Field Manual

N = Sample Size

TABLE 2-3

MEAN COMPOSITION OF PUBLICATION
JOB-ORDERS BY PUBLICATION TYPE

	TYPE OF PUBLICATION				
	TOE N=191	TM N=515	TB N=71	AR N=38	SC N=29
Text					
#Typeset Manuscripts	0.00	7.04	5.25	29.74	1.62
Text or Graphics					
#Camera Ready Masters	18.57	49.35	8.87	66.26	40.86
#Negatives	0.08	43.89	19.44	0.00	130.44
Graphics					
#Halftone Drawings	0.24	0.23	0.30	0.00	0.00
#Linecut Figures	0.26	2.51	0.61	9.95	0.00
#Foldouts (Pasters)	0.00	1.27	0.00	0.00	0.00

KEY:

N = Sample Size
 TOE = Tables of Organization and Equipment
 TM = Technical Manual
 TB = Technical Bulletin
 AR = Army Regulation
 SC = Supply Catalog

TABLE 2-4
MEAN COMPOSITION OF PUBLICATION JOB-ORDERS
BY JOB TYPE AND JOB PRIORITY

	JOB TYPE			JOB PRIORITY		OVERALL
	ORIGINALS N=140	CHANGES N=479	REPRINTS N=389	ROUTINE N=667	EXPEDITE N=343	
Text						
	19.62	8.45	0.22	8.29	3.96	6.82
Text or Graphics						
	19.71	23.17	67.15	49.84	19.71	39.63
Graphics						
	12.93	3.78	63.64	39.77	5.43	28.12
	1.28	0.47	0.02	0.35	0.52	0.41
	3.41	2.89	0.04	2.28	1.03	1.86
	.54	0.09	1.56	1.04	0.09	0.72

KEY: N = Sample Size

TABLE 2-5

WORKLOAD
HQ DEPARTMENT OF THE ARMY
PUBLICATIONS DIRECTORATE*

PUBLISHING DIVISION (Newly Created Documents)						
ITEM	FY 70	FY 71	FY 72	FY 73	FY 74	YEARLY AVERAGE
No. Pages Processed	666,865	596,917	666,278	602,265	667,433	639,952
No. Cases Processed	9,925	8,367	8,578	9,962	10,022	9,371
Avg. Pages Per Case	67	71	78	60	67	69

PROCUREMENT DIVISION (Departmental Branch)** (Total Items Handled, Including Reprints, Supersessions, etc)						
ITEM	FY 70	FY 71	FY 72	FY 73	FY 74	YEARLY AVERAGE
Total Cases Processed	22,530	19,315	19,278	21,033	21,780	20,787
Manhours Expended	48,835	48,020	46,441	40,468	40,741	44,901
Manhours Per Case	2.17	2.49	2.41	1.92	1.87	2.16

*Based on consolidation of Monthly Workload Reports data obtained from the Publishing and Procurement Divisions of the Publications Directorate, TAGCEN.

**For the Procurement Division, figures represent data from the Departmental Branch only, since this is the primary branch involved in DA publications processing.

CHAPTER 3

MICROPUBLISHING, STATE-OF-THE-ART

3-1. General.

a. Phase I of the project's directive included a requirement to determine the current status of micropublishing technologies. This data collection was the initial step in establishing an optimal design for the project's prototype system and for subsequent recommendations to implement a full-scale Department of the Army micropublishing installation.

b. Reconnaissance procedures explored two interrelated areas: current/proposed operating systems; and manufacturer's micropublishing equipment. The first area was covered comprehensively through visits to a cross-section of the federal, state, and private sector micropublishing world. Information on procedures and system design was obtained over the period 1 February 1975 through 31 July 1975. The second area, manufacturers' equipment, was intensively investigated through visits to vendor's plants and consultations with their representatives. For a complete listing of those agencies, firms, manufacturers, and vendors that were contacted by the IMPACT project team, refer to Appendix F. Fact-finding in the equipment area concentrated on available off-the-shelf components, as opposed to drawing-board theory. This limitation was self-imposed because of IMPACT's short study-life. But, where innovative ideas and products were surfacing, any considered system design addressed its replacement and/or retrofit capability (e.g., video discs as illustration storage devices).

3-2. Federal Sector.

a. Both the depth and scope of IMPACT's reconnaissance were most extensive in the federal sector. This direction was intentional since these users were more representative of the Department of the Army environment. To further refine this emphasis, particular attention was paid to DOD users.

b. At this date, micrographics, per se, has had wide and diverse federal usage, but the applications have been highly selective and directed toward record-keeping more than publications. Where applied to the field of publications, such as the Defense Department's MINICATS Program (catalogues on microfiche) or the Navy's TRUMP Program (technical manuals on microfilm), the goal was to solve a discrete storage, compaction or update problem and was not a general approach to the conversion of a full range of publications within an agency. It was

determined that the majority of ongoing installations were involved with micro-republishing (the micro-photographing of printed hardcopy as opposed to micropublishing from original author text and graphic inputs). A total of twelve installation visits were carried out to cover the full gamut of the micrographic technology from conventional camera reductions to fully computerized systems.

c. As an example of the proven state-of-the-art, now underway in the federal sector, the Navy's NAVAIR "TRUMP" operation (Technical Review and Update of Manuals and Publications) is the most sophisticated and proven application. NAVAIR's micropublishing is largely computerized. It scans in alpha-numeric data via CIM (Computer Input Microfilm) and produces cartridge microfilm by COM (Computer Output Microfilm). All associated graphics (line drawings, half-tones and photos) are merged with their respective text through computer callouts for insertions of film negatives to be microphotographed. NAVAIR's basic need for conversion to microfilm was to reduce storage space (compaction); but the sophisticated capabilities of their system also permits the solution of two other problems: first, the rapid updating of microfilm and, secondly, the reformatting of the original hardcopy publication when converted to micrographic media. This system costs-out at over \$4 million, plus hardware/software service-support. At this date, TRUMP's average cost for creating a 24:1 frame on a master film has shown a cost savings of greater than 70% when compared to hard-copy creation of an average page (\$25 vs \$87).

3-3. State Sector.

a. For some time most state (and local) governments have utilized microfilm for storing updatable documents such as vehicle registrations, licenses, etc. Current active proponents of the microform technology are California, Florida, Rhode Island, Wisconsin, Ohio, and Illinois. New York City is presently extensively expanding its micrographics effort.

b. IMPACT's visit to the State Capital of Illinois at Springfield in July of 1975 illustrated the extent to which State governments have progressed. Although a "creature" of the Secretary of State's Office, the facility, since 1957, has handled all State requests for microfilm production. This installation includes the full range of microfilm cameras (rotary, planetary, and step-and-repeat cameras). In addition their installation has two complete COM systems which handle documents created from the various computer systems in the State government. The State Library makes use of the installation to microfilm books, periodicals, and record the documents of the State Assembly.

3-4. Private Sector.

a. Micropublishing has progressed further in the private sector than in either the federal or state sectors. The issuance of catalogues

(Sears Roebuck and Co.) and Parts/Service Manuals (Ford, GM, Chrysler) in microform is now a way of life with many large corporations. The COM approach is in wide use and interaction with the corporation's computers is common place. As with TRUMP and other programs, the driving force for conversion to microfiche has been compaction of data and need for fast turnarounds due to frequent updates. Chrysler, as an example, has compressed 10 feet of parts and service manuals into 18 fiche using 50:1 reduction. GM employs 24:1 and 42:1 reductions, the intent is to move toward 24:1 because of "blowback" problems at the higher reduction rate. Blowback in this context is synonymous with re-enlargement. It applies to equipment which can enlarge any given frame of a microfiche back to the original or larger size of the document. Ford and Sears Roebuck Co. employ 150:1 ultrafiche for parts lists which expands their compaction even more; but this is a result of earlier beginnings and service contractors capabilities. They are not necessarily committed to such high reductions in the future and now as a general rule reduce to 42:1. Their trends in graphics are to convert photos to line drawings, use COM and CIM, and to use viewers-printers as often as viewers.

b. An example of private sector micropublishing state-of-the-art is the Lockheed Missiles and Space Corporation (LMSC) at Sunnyvale, California. Lockheed's system employs a highly sophisticated COM device to produce fiche and film with inputs from its computer tapes. LMSC also uses CAD, (Computer Assisted Design) as inputs to this system. They have the capability to merge illustrations with text through slide inserts as called for by the COM's computer program (similar to the "TRUMP" operations).

3-5. Manufacturers.

a. As a consequence of the extensive reconnaissance in the three sectors of micropublishing installations, the need to explore the total manufacturing universe was curtailed. Through observation of the wide range of equipment under actual operation, the project's focus of interest was narrowed both as to categories of equipment and their specific manufacturers. Those systems and equipment which could meet the mandatory requirements of HQDA publishing were easily isolated.

b. Through earlier surveys of the HQDA publication universe, IMPACT quantitatively established the scope of publications by type and distribution (%'s of ARs, TMs, FMs, etc). The makeup of these items in number of pages and in percent of illustrations per average publication (photos, line drawings, and half-tones), and the average frequency of proponent changes was established. Two prime factors surfaced which emphasize mandatory consideration - one, illustrations were included in over 60% of total pages, and two, 38% of document job requests were for changes to existing documents (not originals). Based on this information, systems or equipment which were not directed specifically toward these needs were excluded from further review.

The sector of the micrographic technology which met these needs completely was that area of COM (Computer Output Microfilming) which could merge text and illustrations; and could quickly manipulate its data base to make changes to documents already on file.

c. At the times that the project members visited or consulted with vendors, only three COM equipment manufacturers could meet the illustration merge requirement. One company no longer produces the equipment but would re-lease units after their leases expired. This company's equipment also was limited in its capability to merge digitized text and negative illustrations on one microfiche frame. A second manufacturer was only in its prototype state of development and has subsequently dropped out of this market. The third and only other manufacturer meeting the requirements, a pioneer in the technique, has steadily advanced in the micropublishing field and at this writing remains as the only system which can merge a full range of illustrations with digitized text.

d. Since any new system will require extensive conversion from the conventional hardcopy to fiche, a micropublishing subsystem for this conversion was included in the equipment review. Such a "front-end" system which digitized hardcopy text would be required to have magnetic media output which would be the input to the next micropublishing subsystem (COM). That is, it would have to be compatible in its interfacing software. And, this software must include the full range of commands and instructions which specify printing format (type and size of characters, vertical and horizontal spacing, column or page length, etc.). Reconnaissance of this field revealed a wide range of equipment which could convert text to magnetic media via keystroke inputs.

e. The last area of equipment to be investigated was the subsystem for development and reproduction of microfiche. Information obtained from observing installations exposed the need for special facility preparations to handle waste water/chemicals and the venting of noxious gas fumes. Since the project's prototype operation did not warrant extensive environmental construction, this subsystem would be excluded from a prototype lease. For the prototype needs these operations would be performed by contracted services. But, as a necessary part of a full-blown micropublishing operation, this subsystem was investigated as a future requirement. There is an overabundance of both development and duplication equipment vendors, and even the more specialized field of development (the full-reversal process), is also readily available. IMPACT's design emphasized the diazo type duplication and found no shortage of fine equipment in this area.

3-6. Review of Reconnaissance Activities.

a. In general, Project IMPACT's reconnaissance efforts provided an education into the "do's and don'ts" of participating in micrographics. On the whole, the investigative actions directed at the current users of the technology were of predictably more value than similar efforts in the manufacturing community. Micrographics as an overall industry is extensive in range and diverse in scope. But micropublishing, per se, as a minor element of the big picture, has not experienced the same industrial growth - few manufacturers were actively concerned with the total publishing requirements. This is principally due to the cost of the more sophisticated systems necessary for full micropublishing and the limited market potential. The federal government agencies, with the DOD as its leader, have surpassed other sectors in the degree of micropublishing sophistication. But, even within this progressive arena, no agency has analyzed its total publication picture as a candidate for microfilm conversion. To date, activities of microforms application have been limited to selective programs (as previously referred to with the Navy's "TRUMP" program) to solve particular and individually oriented problems, e.g., storage space. But whatever the application and whatever its need, no current user has intentions of reducing operations. Firm future plans are designed for increased production and upgrading of systems - that is, conversion from micro-republishing to true micropublishing. In order to capture the pertinent data needed for equipment/system selections a grouping of functional fields of investigation was established, and followed throughout the reconnaissance phase. The general categories and their elements are condensed under the five basic headings of equipment, systems, personnel, installation, and services. The following subparagraphs summarize the significant information gleaned from the reconnaissance phase within these categories.

b. Equipment. As stated in the opening paragraphs of this chapter, IMPACT was relieved from viewing the total universe of equipment and its application to micropublishing systems. Since the established mandatory requirement to fully handle illustrations and be able to minimize revision turnaround time was a defined limiter, emphasis was placed on equipment which was COM oriented and had flexible capabilities for the merge of digitized text with illustration negatives. Therefore, although other equipment/systems configurations were observed, they were early-on preempted from detailed consideration.

(1) Any complete micropublishing system which employs COM as its microfilm recorder can be separated into three subsystems or modules: input conversion; COM recording; and film master development and quantity duplication. A COM device must have an input conversion front-end sub-

system to produce compatible digitized data for COM recording actions. IMPACT reviewed the historical patterns of on-going installations and determined that some micropublishing input was or had been through large computer systems but that the problems of producing true printing and/or merging illustrations with text precluded development of an efficient process.

(2) In view of the above, the approach of using a fully independent but integrated "front-end" subsystem was intensively investigated. Two available text input device categories are available: the more common keystroke to mag-media (typewriter or CRT - Cathode Ray Tube, a visual display screen) and the more sophisticated scanning devices (CIM and OCR - Optical Character Recognition). CIM is available from several sources and has been successfully married to a micropublishing system in the NAVAIR "TRUMP" installation. This system is very expensive (over \$4 million) and requires the conversion of hardcopy to a scannable film negative as input. OCR is a shortcut from author to mag-media but still requires a compatible hardcopy input for use of the scan device.

(3) The more conventional terminals, I/O typewriters and CRTs, are common-place and readily available with a wide range of keyboard configurations. They can be stand alone units or they can be of the shared-logic variety which permit a group of terminals to share the power of a mini-computer. The latter design is well represented in the marketplace but largely as "word processing" equipment with its inherent software limitations in the print formatting fields. To front-end a COM device with any mini-computer input/output system, a full range of compatible software must exist. At the time of IMPACT's investigation no vendor had or would define a software package which could drive a micropublishing-oriented COM device and neither firm prices, delivery, or interest was forthcoming. Although, some software already existed for print-formatting which could drive photocomposition equipment (non-micrographic); no off the shelf packages were available which could interface with COM devices. Costs for developing interfacing software were variously and informally quoted from \$25,000 to \$100,000. It was decided that the best approach was to inspect equipment/systems which had proven interfaces with photocomposition devices as a preliminary to designing IMPACT's own system. Again, few manufacturers had a proven capability in this area.

(4) In the field of COM recording equipment the available choices are limited. IMPACT's specific micropublishing application of COM further reduced the competition. As previously stated, only three manufacturers indicated even an early interest, and only one company could meet the DA publications requirements.

(5) The third module of a COM oriented micropublishing system, development and duplication, has an extensive list of equipment manufacturers. The special services for supporting a COM micropublishing operation, to include COM-film full reversal processing (although a small part of the industry) can be easily procured.

(6) Lease or buy contracts on any of the foregoing equipment have presented no difficulties. Most of the users contacted have elected to lease rather than buy; their assumption being that the micrographic technology is still in an exponentially developing phase. This has some validity in peripheral equipment; but the manufacturers of the more sophisticated devices, particularly COM, state that they have addressed the ideas now on the drawing board and can provide simple compatibilities and/or retrofits. This is evident in the development of interfaces for the upcoming video disk storage devices that can be adapted to the current input/output channels.

(7) Users have emphasized that any contract with manufacturers, original equipment manufacturers, or third-party lessors must address each user's particular set of needs. Purchasing on a standard set of contract specifications which are relatively general in nature has beset some users with less than optimal systems. The need for well defined benchmarks and acceptance tests with applicable penalty clauses to cover delays and insufficiencies is advocated by all levels of equipment users.

(8) System delivery has been a problem at several installations, and piece-meal deliveries are as much a problem as are total late arrivals. Again, if penalties were invoked this habit could be curtailed. Maintenance/service of equipment varies from the ridiculously haphazard to the well defined preventative maintenance programs. Where the home base of the service center is not in the immediate locale, it has been found that response to calls can be much delayed and is seldom predictable. Although some companies back up their maintenance inadequacies with free lease periods matching the lost time caused through these delays, this is no solution when the production schedules are critical. Penalty clauses should be written to match lost production.

(9) On-the-job training is the prevalent type of training at most sites. But those systems which employ computer-based equipment require formalized classroom sessions. Manufacturers of systems (COM and mini-computer based) supply excellent well programmed courses. These programs are bundled or buried in the overall costs. Best results of this type of training are achieved when: (1) conducted at the home site on the actual user equipment or (2) when conducted at the vendor's plant/service site on identical equipment.

c. Systems. All of the observed micropublishing operations had specialized and particularized objectives that ranged from the need for compaction of records to the total creation and/or recreation of technical manuals. Each individual system, because of its specific needs, was designed with little concern for expansion into other areas of microfilm conversion, and these beginnings have rigidly limited their future scope. As an example, the Southern Bell Telephone Company's requirements at its Atlanta, GA installation were dictated by a need for accurate and timely (24 hours) revisions to its directory index information as supplied by special information telephone operators. Although their operation is a marvel of timeliness, its design requirements can severely limit its use for other COM applications, such as documents with merge of digitized text and illustrations. This is also true of those stand-alone COM systems which employ COM as a substitute for an off-line printer at the USAF Electronics Printing Systems Branch and the Los Angeles Lockheed Plant. Many of the installations contacted expressed their position as economical - and as funds became available their plans were to first move to COM and continue to expand in the digitized data base mode. In those cases where COM was in use - whether stand-alone COM, COM with CAD, COM with CIM or any combinations thereof, all users were in complete agreement that the cost savings realized and the greatly improved turnaround times, fully supported the conversion from hardcopy to microfilm and/or conventional micro-republishing to micropublishing.

(1) Systems software has not been a problem in using COM, that is, as long as the COM inputs are produced on the larger computers and do not require the extensive sub-routines of a full-graphics operation. Of the few users of independent mini-computer front-end subsystems, none have had total success. Their experiences would indicate that the problem lies in various degrees of incompatibility of the software systems, and that the fault may lie in the proprietary nature of software packages which could be restricting cooperative efforts between manufacturers.

(2) As previously noted, the cost of special interfacing software between a mini-computer front-end and a micropublishing COM had in 1975 been variously suggested as \$25,000 - \$100,000 - and usually would be undertaken only on an R & D basis. A more recent quote indicates that \$25,000 will soon be a probable competitive cost for a complete package.

d. Personnel. Although none of the COM-based installations visited had identical personnel staffing, each configuration was composed of the same representative skills: management, computer specialists, photographic technicians, print-format editors and input terminal operators. As can be seen in this list, only one specialty, the editors, must have some prior reliance upon printing as a necessary background.

This experience was found to be useful when digitizing hardcopy to mag-media for the interpretation of spacing and size of characters. Managers of installations are usually multi-disciplined individuals with combinations of expertise in electrical engineering, mechanical engineering, chemistry, photography, and computer science, as well as a sound formal basis in business management. At all the visited installations which employed COM, managers and supervisors had formerly held ADP positions and were well acquainted with the science far beyond the seminar level or peripheral training courses.

(1) The general rule for acquiring operating personnel has been that you must develop them yourself. The marketplace has few micropublishing recruits, and when they do appear their talents are often not compatible with specific needs and they must therefore be retrained. The majority of micropublishing sites have recruited their technical personnel from the data-processing ranks. This applies to both managers and operators. Some photographic talent has been retrained but generally the ADP oriented individuals have acquired this capability and fill in as needed.

(2) With respect to talent/salary levels the general rule is that only managerial and supervisory positions go beyond GS-11 or the salary equivalent. Computer-oriented positions ranged from GS-5 to 11. Editors ratings are GS-5 to 9 and console operators rank from GS-3 to 7 equivalents. All classifications are stepped for career paths. A manager's responsibility within the operation is determined on a functional division basis; but all those contacted were either ADP experts or had significant and in-depth experience in the field.

(3) Specialization exists within installations but cross-over between expertise is common, e.g., computer specialists and photographic specialists. Questions to installation managers about the lack of personnel with printing backgrounds provided two types of answers: one, personnel with conventional printing background are not necessary to the operation, and secondly, if available, printers as such, have not proved adaptable to the required changes brought about by a completely different technology.

(4) Training methods varied from OJT with little organized or formal lectures to full scale multi-week hands-on/lecture education at the manufacturers' plant-sites. Offsite training was considered unnecessary unless the equipment associated with the education was not fully available at the installation site. Training is universally considered to be a continuous action. The majority of the managers' experiences indicate that all job functions take 4 to 6 months to acquire journeyman status.

e. Installation Considerations. This category of information can be divided into two facets: the physical concern for site preparation and the systemic concern for implementation. The first consideration includes space and facilities, whereas the second focuses on the plan for installation/operation over time.

(1) Space is a prime concern, and most visited operations had installations that had outgrown their original requirements. Aside from the adequate desk/terminal space required, the COM and mini-computer space allocation is the most important consideration. Visited installations had isolated these units: first, because they demand limited environmental ambience in temperature and humidity, and secondly, to protect the equipment from various types of damage. Photographic darkrooms, film development, and associated camera work have also been assigned individual closed areas. Besides the obvious darkroom needs, the areas for film processing must have special facilities for disposition of chemicals through conventional drains and provision for water supplies to be filtered and correctly heat-controlled. When duplication is by ammonia-based processes, there must be allowances for venting of any noxious fumes. None of the installations had any difficulty in these areas and as a universal rule their housekeeping was spotless in all areas including those for chemical storage.

(2) Lighting is a concern, in that all phases of micropublishing from text input operations through final inspection of microfilm require more than adequate lighting, based on human demand as opposed to recommended calibrated lumens. The overall aesthetic affect of various observed systems was from basement type decor to a high level of interior decorating. Most COM installations adhered to the computer room concept - bright, tiled, unembellished and well lighted.

(3) Implementation has not been without some problems; but other than late deliveries of equipment they have been minor. Plans of visited installations were always well defined and built-in allowances for vendor oriented delays have permitted on-time change-over dates.

f. Services. None of the installation managers questioned had found services to be a problem. Suppliers are close at hand and can give a one day delivery if needed. The quality of chemicals, film, ADP supplies and paper products is in the "you get what you pay for" marketplace. Service agencies for development of master film and its duplication in quantity are adequate in most localities. Response time varies; but 24 hour turnaround is standardly accepted - depending on order size. Service houses are of great value to an installation since their expertise in film processing and duplication procedures can eliminate much scrap on the part of the producing installation.

3-7. Lessons Learned.

- a. Starting point for new operations is the proven "state-of-the-art".
- b. Manufacturers/vendors should only assist not direct.
- c. Equipment/systems must be accurately and completely tailored to individual user's needs.
- d. Micropublishing personnel are made not bought - but recruits require a good general background with specific experience.
- e. Plan any installation well and plan it well ahead.

CHAPTER 4

SURVEY OF POTENTIAL MICROFILM USERS

4-1. General.

a. In order to develop a successful Army micropublishing system consideration was given to user requirements and constraints. Accordingly, a survey questionnaire was needed to evaluate potential Army - microfilm - users' needs, attitudes, and limitations related to micropublications. This survey would serve as input to answering the what, when, and how to micropublish. To contribute this input, a clear, comprehensive survey was essential. A survey was needed that was appropriate for personnel of varied backgrounds and talents Army-wide. To assure maximum clarity and completeness, a three part trial survey was developed (Appendix G). Responses from this trial survey would be used to shape a finalized edition, herein called the Revised Survey (Appendix H). Trial survey findings would also serve as a check on the revised edition. The trial edition was divided into Management, User, and Potential User versions. Each respondent replied to only one appropriate version. In the three versions, information was collected on current paper copy requirements; publications space and handling needs; and projected reaction to microform conversion.

b. The original trial survey was distributed to the majority of major command (MACOM) headquarters, where a large number of viewers and viewer-printers were already in use. Responses from this group yielded information on a vital group of likely microfilm users. In addition, because of the relatively static office environment of a MACOM headquarters it was ideal for use as a survey testbed. The returned MACOM questionnaires revealed needed changes in questionnaire content and format to build an improved, finalized edition (the revised survey). Needed survey modifications were implemented following the processing and analysis of the machine-read trial survey answer sheets. This revised survey was then readied for the more extensive Army-wide distribution.

c. The revised survey's distribution included major FORSCOM units in both CONUS and OCONUS. In addition, the major command headquarters were resurveyed. Therefore, personnel from MACOM level down to the first line troop levels were able to respond to this second version.

d. In contrast to FORSCOM, TRADOC has different publication needs, most often in high usage, training environments. Such environments are not as prepared to accept micropublications without great procedural changes and special training-oriented equipment. Thus, TRADOC

was excluded in the survey distribution. Following preliminary site visits, it appeared that for initial Army microfilm conversion, FORSCOM units would be the better equipped and least costly alternative.

e. Data from the revised survey served several important purposes. First, the data provided direct input to the selection of a micropublishing system prototype. In effect, the survey aided in answering questions on publication type, usage environment, and conversion procedures for micropublishing. Second, much descriptive information was revealed on the needs and environment of a representative cross-section of potential FORSCOM and MACOM users. This information aided in identifying the necessary configuration and demands of the micropublishing system. In addition, by obtaining MACOM data from both the trial and revised surveys, it was possible to examine response consistency, and to insure reliable sampling. As a third benefit, the survey yielded inventory data on currently available viewers, projected needs for viewers upon conversion, and types of publications used and stored.

4-2. Methodology - Original and Revised Surveys.

a. Distribution and Returns.

(1) The original trial survey was administered to fourteen MACOM headquarters. One hundred copies of each survey version were mailed to each of the commands appearing in Table 4-1. Thus, a total of 1400 copies of each version of the trial survey were distributed. From requested MACOM projections, it was determined that 100 copies of each survey version would be "more than adequate" to cover each command. Overall response rates for each survey version were based on 100 copies per command. Actual numbers of potential survey respondents may have been less at any one command. For the Management version the response rate was 19% with 263 surveys being received. Microfilm Users returned 22% or 304 surveys and Non-Users of microfilm responded with 785 surveys or 56%.

TABLE 4-1

TRIAL SURVEY DISTRIBUTION

US Army Forces Command
US Army Training and Doctrine Command
US Army Europe and Seventh Army
Eighth US Army
US Army Military District of Washington
US Army Communications Command
US Army Computer Systems Command
US Army Health Services Command
US Army Missile Command
Development and Readiness Command (formerly Army Materiel Command)
US Aviation Systems Command
US Army Electronics Command
US Army Tank/Automotive Command
US Army Test and Evaluation Command

(2) The total of the revised survey distribution was 8,792 questionnaires. As with the trial survey, numbers of surveys distributed to participating units were based on projections. These projections were determined from relative unit size and make-up, as depicted on organizational charts. Response rates were based on these projections. Actual numbers of potential respondents may have been less in any one command. Of the 7,592 revised surveys distributed to FORSCOM units, 4,308 were returned for a response rate of 57%. The percent of return is illustrated in Table 4-2. It should be noted that all of the surveys shipped from the 6th Air Cavalry Combat Brigade, Ft Hood, Texas and a large portion of Communications Command, Ft Huachuca, Arizona were lost in shipment and this data was unrecoverable. These were thus unavoidably excluded from the analysis of data.

(3) One hundred copies of the revised survey were distributed to each of the 12 MACOM headquarters for a total of 1,200 (see Table 4-1). The response rate was 74% with 889 surveys returned. As with the trial survey, response rate is based on a projected number of potential respondents. Surveys from USAREUR and Eighth Army MACOM headquarters were combined and shipped with those for their constituent units to aid in the overseas mailing process. Integration of these returns necessitated a combined analysis of headquarters and unit surveys for these two commands.

TABLE 4-2
REVISED SURVEY DISTRIBUTION
FORSCOM UNITS

	# COPIES SENT	RETURNS	% RETURN
2nd Armored Division, Ft Hood	840	424	50%
24th Infantry Division, Ft Stewart	780	442	57%
4th Infantry Division, Ft Carson	875	385	44%
82nd Airborne Division, Ft Bragg	840	597	71%
101st Airborne Division, Ft Campbell	920	562	61%
197th Infantry Brigade, Ft Benning	350	167	48%
194th Infantry Brigade, Ft Knox	455	335	74%
Eighth Army, units (Including MACOM HQ)	730	574	79%
USAREUR units (Including MACOM HQ)	1300	809	62%
6th Air Combat Brigade, Ft Hood	235	0	0%
Communications Command, Ft Huachuca	200	10	5%
Uncategorized		13	
TOTAL	7096	4309	57%

b. Survey Coordinator Appointment.

(1) Before distributing the trial survey a request for appointment of survey coordinators was initiated under the authority of The Adjutant General, through the commanders of the major commands. It was each coordinator's responsibility to distribute surveys in a way that would be representative of his entire headquarters. The coordinator was also responsible for collection and return shipment of the surveys.

(2) With the revised survey, coordinators were appointed by the unit commanders, through the authority of the Commander FORSCOM. For the MACOM headquarters, coordinators remained the same as for

the trial survey. Coordinators were again responsible for distribution and collection of surveys in their respective organizations. This survey differed from the trial survey in that a recommended distribution list of specific elements within each FORSCOM unit was submitted to the survey coordinator to assure representative sampling. Within each organization, numbers of questionnaires to be administered to particular elements were specified and appropriate quantities shipped. The MACOM headquarter's distribution method remained the same as for the trial survey.

c. Survey Coordinator Instructions:

(1) In addition to the basic respondent instructions included on the trial survey, each of the three versions of the survey included a specially prepared instruction sheet to aid the coordinator in his management of the survey administration. In the instructions the recipients of each version of the trial survey were defined: Managers were defined as microfilm users serving as, installation commanders, branch chiefs, company commanders, etc.; microfilm Users included those personnel other than managers, who were presently using some type of microform system; and Non-Users included both managers and non-managers having no personal involvement with any type of microform system. Since the trial survey was answered on computer processable "Mark-Sense" answer sheets, instructions for preparing these were added to the coordinator's instruction page.

(2) The revised survey, as with the trial survey, also included an instruction sheet for the survey coordinator. Since this edition of the survey was shorter, directly keypunchable, and produced in only one version, instructions were much less complex. As in the trial survey instructions, anonymity was assured and no identifying personal information was requested.

d. Analysis Procedure - Trial and Revised Surveys. In order to handle the volume of survey items and responses, the questionnaire data was reduced and processed through automatic data processing. Standard statistical procedures particularly suited to survey data were used to reduce and analyze the surveys' returns. It should be noted that, response percentages reported for particular survey items do not always equal 100%. For these cases the remaining percentage is effectively accounted for by the "other" or "no response" categories. For more specific response breakdowns for key items, see Appendices I and J.

4-3. Findings.

a. General. Considering that the response rate amounted to 19% (Management), 22% (Users), and 56% (Non-users) for the trial survey

and 57% (overall) for the revised, returns adequately represented the total universe of Army users and potential users of microfiche. In the following report of the survey findings only the more significant findings are reported.

b. Trial Survey (Management Version).

(1) Consolidation of the data provided information regarding current paper file system needs and procedures. For management's current paper files, it was reported that reference publications and numbered directives consumed the largest percentage of total available file space (from 20-30%). Reference catalogs and correspondence comprised the second largest category of occupied space at a reported 10-20%. Questions regarding the kinds of personnel involved in file-maintenance suggested that personnel in grades GS3 - GS6 were assigned the largest percentage of this activity and grades W1-W4, the least. All other classes of personnel had some reported file maintenance activity between these two groups. File maintenance time was determined to be 1 to 3 hours per day for those grade levels who had the greater involvement.

(2) Survey items designed to obtain the amount of filing equipment in the work areas indicated that secured and unsecured two drawer and four drawer files existed in average frequencies of 0-4 units. Automatic and bookshelf files were present at an average of 0-2 units in each work area. These reports on filing equipment emphasize the possible space saving feature of microforms. This data will influence the selection of document types for future microform conversion.

(3) At some headquarters survey sites, microfilm products were already available. Inquiry into the amount of filing space these products demanded, determined that microfiche, aperture cards, and roll films, where used, consumed 0-5 inches of filing space each. Cartridge filing inches ran from 0-5 up to 45-50 inches. For all types of microfilm products in use, the most frequently used reduction ratios were reported to be 24:1 and 48:1.

(4) In determining the extent of managerial personnel experience with microfilm, related survey items revealed that the greatest experience had been with microfiche and microfilm cartridges, and that 35-43% of the respondents had at least some microform involvement. Forty-four percent of responding managers reported that from their vantage point, positive user reactions was evident. For the remaining 56% of the managers, user reaction was viewed as either uncertain (24%), "unacceptable" (16%), or no response was given (16%). Viewers and viewer-printers, where available, were viewed as satisfactory or very

satisfactory by 50% of the managers, while others responded unsatisfactory (15%) or uncertain (13%). Microform training was considered non-existent or inadequate by 38% of the respondents. Other respondents reported training to be in the "adequate" (25%) or uncertain (23%) categories.

(5) Microfilm was thought to have a beneficial effect on work production by 29% of the managers. Thirty-four percent of the managers felt microforms would have no effect on work production, while 16% believed microforms would have an adverse effect. Expanded use of microfilm was believed beneficial to work production by 26% of the managers, to have no effect by 43% and to have an adverse effect by 24%.

(6) When asked how often a paper copy of a publication was required, managers responded as follows:

<u>% PAPER COPY REQUIRED</u>	<u>% MANAGERS</u>
1-5% of the time	48%
More than 5%	29%
No Response	23%

The majority of managers (59%) reported use of microfilm at least occasionally in their work, and others responded that they used microfilm often (9%), or very often (5%). Twenty-two percent were not using microforms at the present time. The office environment was indicated as the most frequent microform usage area.

(7) Twenty-four percent of the respondents replied that microfilm was produced in-house. An additional 24% indicated sources other than contractors, as their film supplier. Still others (21%) did not know the supplier. Fifty percent of the managers revealed that in-house reproduction capabilities were also present. If an extended use of microforms was initiated, most managers projected a need for at least 1-2 more viewers and viewer-printers, in addition to the 1-2 unit average number now in place per site.

c. Trial Survey (User Version).

(1) This survey version was intended to include all microfilm users other than managers. Amount of daily on-the-job microfilm usage for the user group was reported as SOMETIMES (50%), OFTEN (25%), or VERY OFTEN (14%) with only 8% responding NEVER. The average

amount of time per week committed to using microforms amounted to 0-5% of the total work week. The transition to microfilm from hardcopy was rated not difficult or very easy by 65% of this group. Sixty-six percent, however, indicated that they did not have a contributing voice in the microfilm conversion program. Training received during this conversion was considered adequate by 47% and insufficient by 42%. Overall, fifty-one percent of the user group believed that work was easier with microfilm, while 44% favored paper publications. If further publication conversion should occur, 31% of the user respondents expected work would be easier. Other users expected work to more difficult (30%) or were uncertain (38%).

(2) In previous usage of microfilm products, users had developed certain needs and preferences. Microfiche (40%) was reported to be the most used type of microfilm followed by cartridges (38%) and aperture cards at (15%). When asked which type was preferred, a slight preference for cartridges (40%) was indicated over microfiche (37%). Reduction ratios of 24:1 and 48:1 were used, but a preference for 24:1 was reported by most users. A desire for positive microfilm images was suggested over negative images. While using microfilm for look-up tasks, half the respondents felt a paper copy was also needed 1% of the time and half believed more than 5%. When paper copy was needed, the reasons most often given were for making notations or to forward to a requestor.

(3) Most individuals related that the existing viewer equipment was located in a central office area. This viewer location was believed satisfactory by most users. The quality of these existing viewers was also considered adequate for most user's needs.

d. Trial Survey (Non-User Version).

(1) All headquarters non-users, including managers, responded to this version. In questions establishing which paper documents were receiving greatest use, 71% of the non-users reported numbered publications (e.g., ARs, TMs), as high usage documents. Forty-eight percent reported management data reports (e.g., SIDPERS) in the high usage category. Least used paper documents for this group were supply catalogs and technical bulletins, with only 4% and 3%, respectively, reporting frequent use. Such usage information will aid in determining initial publication selections for microform conversion.

(2) With micropublications, 37% of the non-users projected that a paper copy would be needed for 1 to 5% of all look-ups. Sixty-one percent projected a paper copy need with more than 5% of all look-ups. When publications were used, the most frequent usage area was

the general office environment. Publications were least used in field exercises. Although this group was not currently using microforms, 61% indicated some microform usage elsewhere. This prior usage was reported to be mostly with fiche and least with aperture cards. In observing others using microforms, most non-users observed favorable reaction toward the features of microform products. When asked about their willingness to try microforms, 88% of the respondents replied "Yes" and 10% responded "No", indicating some open ground for user education. User education, properly administered could kindle the needed enthusiasm and acceptance to maximize the success of micro-publishing.

e. Revised Survey - FORSCOM Units Data.

(1) As an extension and refinement of the original survey, the revised version explored the specific needs and handling requirements of paper publications for the potential microform user. The greatest number of survey respondents, 64%, fell within the E4-E7 enlisted grades, and the 03 officer grade. Army branches most represented included Quartermaster - 15%, Field Artillery - 10%, Adjutant General - 10%, Infantry - 9%, and Signal - 8%. The majority of the survey respondents were either at the Company/Battery/Troop level (31%), or at the Battalion/Squadron level (20%).

(2) Troop units with a mission to be ready for deployment on very short notice or "quick reaction units", were determined to have special viewer requirements. These units would likely require a dual voltage viewer designed for severe service use. In questioning whether the survey respondent's unit was of this "quick reaction" variety, 79% responded, "Yes", 16% "No", and 5% "Did Not Know."

(3) In addition to viewer requirements it was necessary to determine specific publications for initial microform conversion. Related survey items revealed that 56% of the respondents reported the Army Regulation as their most used publication. Technical Manuals were reported in the most used category by 18%, and Field Manuals by 8% of those surveyed. The rankings of high usage publications are shown in the following table with percentages of respondents reporting each.

TABLE 4-3

MOST USED PUBLICATIONS		SECOND MOST USED PUBLICATIONS		THIRD MOST USED PUBLICATIONS	
	%		%		%
PUB	RESPONDENTS	PUB	RESPONDENTS	PUB	RESPONDENTS
AR	56%	DA Cir	13%	DA Pam	14%
TM	18%	DA Pam	13%	FM	10%
FM	8%	FM	12%	DA Cir	9%
		AR	10%	MISC Pub	8%
		TM	9%	TM	7%

The most used publications under field conditions were reported to be the Field Manual, Technical Manual, and Army Regulation, in that order. It should be noted that the high usage field publications also appear as high usage items in garrison. This finding reinforces the need for a micropublishing system responsive to both environments.

(4) It was necessary to determine how the characteristics of micro-publications would alter current paper copy using patterns. Certain survey items addressed this issue. Army Regulations and Technical Manuals were presented as those publications taking longest to receive after ordering. These publications were reported to take from 6-12 weeks by 48% of the respondents. Other respondents experienced greatly varied order-receipt times. Forty-eight percent of the respondents indicated at least the occasional requirement to order greater quantities of publications than needed. This action seemed to indirectly assure receipt of adequate quantities. Adequate quantities, however, were not always on hand. Seventy-two percent responded with frequent or very frequent needs for publication sharing. Greatest number-of-copy requirements were indicated for Army Regulations by 31% of the respondents, Field Manuals by 12% and Technical Manuals by 27% of those surveyed.

(5) For certain types of organizational units, such as Ordnance, Armor, Aviation and Field Artillery, respondents reported that publications were often lost or rendered unusable by becoming dirty, torn, or wet. Here the higher durability and quick preparation qualities of micropublications would be of great benefit.

(6) Seventy-eight percent of the respondents either often or occasionally made written notes on publications. In addition, 71% reported often or occasional use of publications at home for study.

These publication handling trends will need to be addressed in user training and viewer selection. Further discussion of publication handling will be found in Chapter 7.

(7) Respondents were requested to project their work area microform viewer needs under various possible conversion conditions. Most respondents (58%) reported a need for 1-2 viewers in their work area if all administrative publications were on fiche. If all doctrinal publications were on fiche 57% reported a need for 1-2 viewers. With all equipment publications on fiche a projected need of 1-3 viewers was suggested by 60%. Should all supply publications be placed on fiche, 54% responded with a need for 1-2 viewers. Other responses for projected viewer needs varied greatly. No viewers were required by some individuals in certain publication categories since no publication usage was involved.

(8) Currently available viewers in the surveyed FORSCOM units appeared to be minimal. Fifty-seven percent of the respondents reported no viewers in their work area, and 33% indicated only 1-2 units (see Appendix J). This information suggested the extent of viewer and related training needs for the IMPACT user field test and for any subsequent implementation.

(9) Most respondents indicated some prior contact with a microform product. Forty-eight percent used microforms before and thirty-six percent observed others using the product. These prior experiences appeared to generate a positive attitude toward the use of micropublications. By statistical analysis, it was determined that 54% of those respondents who had used microforms before, were also those who predicted positive user reaction. Overall, 76% of those responding, projected positive user reaction, and 78% predicted improvements in organizational work production.

(10) Although most respondents could see the benefits of micropublishing, certain benefits were reported to be more important than others. Space savings, faster look-up and no change-page-posting were listed as the greatest benefits. The strongest reported secondary benefits were the capability for a larger reference library, and less bulk for field carry.

(11) The usual frequency of change-page-posting was reported by 72% of the respondents to be, "as received." This high frequency reinforces the reported belief that this would be a primary area to benefit from micropublishing. With micropublishing, change-page-posting would be reduced to replacement of the affected publication microfiche, with a new updated microfiche.

f. Revised Survey - Major Command Headquarters (MACOM) Data.

(1) Most of the respondents from the MACOM group were civilians (73%). Officers comprised 5% of the group and the E7-E8 enlisted grades accounted for 4%. Significant findings for the MACOM HQ group suggested that Army Regulations were the most used publication type by 75% of those responding, while DOD Reg-Manuals, DA Circulars, and DA Pamphlets were also listed as high usage. Very few responses were elicited for the use of technical or supply literature. Greatest copy requirements were reported for Army Regulations by 56% of those surveyed. Sixty-eight percent responded that Army Regulations were also the most used publications in the work area reference library.

(2) Occasional need was reported for ordering more publication copies than required to assure adequate quantities. Four to six weeks was the most often indicated receipt time for publication orders. As presented earlier in this report, FORSCOM units, on the average, experienced twice this order time.

(3) The need for publications sharing or for writing notes directly on publications was reported "infrequently"/occasionally" by the majority of this group. In contrast to users of technical manuals in FORSCOM units, MACOM publication users rarely encountered dirty, torn, or wet publications.

(4) The MACOM's as a group tended to include more individuals with prior microform experience than any of the FORSCOM units. Fifty-three percent indicated some prior usage. Perhaps higher grade levels and greater experiences of MACOM personnel have contributed to this result.

(5) Existing microfilm viewer equipment was similar to the FORSCOM units. Sixty-five percent stated that no viewers were available in their work area, while 27 percent indicated one viewer in their shop.

(6) Fifty-nine percent of the MACOM respondents indicated a definite positive reaction toward using micropublications, while 62% estimated positive effects on work production. The greatest perceived micropublishing benefits, as with FORSCOM respondents, were space savings in-house and in the field, and no change-page-posting.

4-4. Discussion.

a. The combined analysis of the original and revised surveys revealed much information regarding the current Army System of using paper publications. Combining both surveys, over 6,000 Army personnel

were queried covering a wide variety of grade and occupational categories. Army military and civilian personnel were given an opportunity to discuss the relative merits and failures of paper publications.

b. In most MACOMs and in a few FORSCOM units there were a number of individuals with current microform experience. For the majority of these respondents positive opinion was indicated toward the operational features of microforms. Few difficulties were reported in converting to microforms or in learning to use microform equipment. These findings suggest that microforms can and do work in certain Army environments. In the private industrial environment the economic and operational benefits of micropublishing have long been established. It seems reasonable then to explore further Army usage of the medium.

c. The surveys revealed that regular publication users are not content with many of the handling features of paper documents. The most serious operational complaints centered around storage requirements, untimely receipt of publications, changes to publications, and inadequate copies. These problems are among those that can be addressed by micropublishing.

d. Sparse microfiche viewer availability was reported by FORSCOM respondents and later confirmed by field site visits. This finding, coupled with projected viewer needs from the survey establishes a realistic overview of future viewer requirements during implementation. In functional areas other than supply, where microforms are currently in use, levels of responsibility for viewer procurement must be determined at a later date.

e. In reviewing many of the unsolicited survey comments, some patterns seemed discernible. For the most part, negative comments were based on lack of knowledge or misinformation about the features and options available in a microform system. In many cases, respondents were unaware of portable viewers for field use. Other respondents did not understand how microforms were handled and stored. Indeed, some respondents had never encountered microforms at all, and expressed typical apprehensions toward a new medium. On the other hand, positive comments appeared to be based on some contact or experience with microforms. Once beyond the new product introduction period, most individuals recognized that a period of adjustment would follow. This adjustment period was then seen to be followed by a period of acceptance and then one of preference. Overall, the surveys suggested that a predisposition for micropublishing does exist in the Army, especially in the administrative area. Greatest resistance appeared in the functional areas of maintenance and training where more dramatic operational changes will be required.

f. The surveys have contributed valuable information toward tailoring the IMPACT system to user needs. Initial publication selection for conversion will include most field recommendations from the surveys. Special environmental needs of all potential users will be considered in reader selection and placement. Particular emphasis will be given to eliminate current paper copy problems. Further, a successful microforms implementation will need to be fortified with the right blend of user education and command support.

g. Throughout the implementation an effort should be made to highlight and reinforce system benefits for the user as they materialize. This ability to demonstrate immediate user benefits will aid in positive attitude development and successful conversion. The surveys, in effect, established a baseline from which to observe and highlight the benefits of the prototype system. A user questionnaire administered at the completion of the eight week User Field Test (discussed in Chapter 7) will indicate user reaction to the prototype system in a tactical brigade environment.

4-5. Summary. Two surveys were distributed to Army personnel to evaluate potential-microfilm user needs and attitudes. The first survey was distributed to 14 major command headquarters (MACOMs) and the other to certain MACOMs and selected FORSCOM units. In this way a representative cross-section of potential MACOM and FORSCOM users was considered. Significant findings included an uncovering of generally favorable attitudes toward micropublishing, along with a small body of resistance. Army Regulations were reported as the most used and most recommended publications for early micropublishing. Ordering and usage problems for ARs and other high usage publications were surfaced. Existing viewer equipment and related training were considered minimal. Micropublishing benefits were recognized in space savings, faster look-up, and elimination of change-page-posting. Although prior microform experience was slight for most personnel, respondents in general expressed a willingness to try the medium.

CHAPTER 5

PROTOTYPE SELECTION

5-1. General.

a. The Adjutant General's Memorandum For the Project Director, Project IMPACT, dated 6 February 1975, chartering Project IMPACT, includes as a main objective (paragraph 3c(6)) the design and evaluation of a micropublishing prototype system (Appendix A). Funds allocated for this system (leases and/or services) were initially estimated at \$177,192.00 (paragraph 4d(3)(b)). The decision, whether to spend these funds to lease a system for an in-house operation or to contract for a total service approach, was to be reached through a comparative cost benefit analysis. Although the above Memorandum recommended a COM oriented micropublishing system (based on earlier ad hoc study conclusions), the final selection of the prototype was also to address other micropublishing techniques if they could meet the required HQDA publication needs.

b. In order to make a reliable decision on which micropublishing system should be recommended as the DA approach to conversion of its applicable documents, project participation in the data collection of thruput times and costs was deemed mandatory. That is, since the decision on how to micropublish would be based on a cost benefit analysis, extensive and complete empirical data were needed. Because the micropublishing systems which had been inspected in the reconnaissance phase did not meet the DA requirements, although some elements were generally applicable to the DA concept, they by themselves were inadequate and/or unreliable regarding the specific data required. The same situation was encountered when analyzing manufacturers' claims, which were overly general and did not address the DA design problems of interfacing other subsystems. Concisely restated: no micropublishing system currently existed which could meet the Project's requirements for either analysis as a prototype or eventual implementation into a full operating system.

c. At an early stage of the study the textual and graphic composition of HQDA publications was identified and quantified through spot surveys and inspection of actual production records. As was stated in Chapter 2, the majority of requests submitted for publication and/or republication contained extensive graphics material (photos, line-drawings and halftones), and a large percentage of these requests were subject to frequent changes in the original

document's material. These points emphasized two mandatory capabilities which must be considered when selecting an Army micropublishing system. First, it must have the capability to handle the inclusion of much illustrative material - both as full single pages and as merges of text and illustrations on a single page. Second, it must include a rapid thruput production capability to expeditiously return updated and changed publications to the field.

d. Of the various techniques investigated, two separate micropublishing processes were available for conversion of existing publications and for creation of new documents which include illustrations. One is the conventional micro-republishing method of micro-photographing old paper copy or plate-ready paper copy. The second is through sophisticated COM film recording with computer controlled merging of digitized text and any associated illustrations. Therefore, in respect to the mandatory requirement to handle conversion of text with illustrations, the micro-republishing process requires the full range of publishing tasks to produce a photographable page. Whereas, COM processing must digitize text through keyboarding and prepare the associated illustrations for negatives mounted on merge slides. The second mandatory capability of a selected system is the expediting of changes made to current publications. In the conventional micro-republishing technique, whenever additions to, deletion from, or changes in text occur on a page, they can cascade any following data through many successive pages. This "domino" effect obviously greatly affects the cost of any change since each affected page must be redone through the total process for creating a photographable page. COM-based micropublishing handles these actions by changing the data base and automatically repaging the affected data to offset the cascade effect. This can significantly reduce the cost of changes and shorten the time lag from "change to reissue" of publications.

e. Since the two above system capabilities were deemed mandatory, the selection process was greatly condensed. This did not mean that other requirements would be excluded; only that the credentials of any system must address the two prime prerequisites if it was to be considered. Having identified the two basic system choices for a prototype, the method of its operation, either in-house by Project team members or through contract services, was then determined. This choice was evaluated on a comparative cost benefit basis as well as production requirements.

5-2. Selection Process.

a. In order to establish the parameters for a final selection of IMPACT's micropublishing prototype system, several areas of the reconnaissance effort needed to be addressed. Before it could be determined "HOW" the Department of the Army should micropublish, it was necessary to specify the "WHAT" and "WHEN" to micropublish. Previous chapters have noted mandatory considerations relevant to these two questions. This section will first concentrate on these points; next apply them as system delimiters; and then present the final selection process in detail.

b. WHAT to micropublish is the decision concerned with selecting that portion of the HQDA publications universe which should be converted to microfilm. The WHAT must meet two criteria: first, they must be technologically and economically able to be converted from present hardcopy forms to microfilm, and secondly, there must be no reduction in the level of efficiency of its ultimate users in the performance of their duties.

c. The annual HQDA publication universe was defined through an extrapolation of the job-by-job data recording of the calendar year 1975 first quarter's publishing requests. This data was obtained through a joint effort on the part of operational publications personnel in TAGCEN and the Project IMPACT staff. From the analysis of this data base, in conjunction with information on production costs gained in the reconnaissance of users and vendors in the micropublishing arena, initial estimates of the significant cost savings of micropublishing were supported. Although large savings in the conversion of hardcopy to microfiche appear to be in distribution and storage of publications, the production of microfiche must first exist in order to realize these inherent savings. Therefore, IMPACT's prime concern is with the costs of producing publications in microfiche over those of conventional hardcopy.

d. It was from the project's composite data base analysis that the requirements of any selected micropublishing system design were established. The data base is composed of three separate data inputs:

(1) The STARPUBS report (Study of the Army Publication System) of January 1975.

(2) A manual survey sampling of HQDA documents through a random technique.

(3) A tabulation of the IMPACT data base elements secured through the 1975 first quarter records of job requests for publication.

A composite of these separate inputs is presented in the following breakdown of job requests by functional type:

TABLE 5-1

HQDA PUBLICATIONS REQUESTS
(BY CATEGORY*)

<u>I</u> <u>9.1%**</u>	<u>II</u> <u>23.4%</u>	<u>III</u> <u>55.4%</u>
Army Regulations	Field Manuals	Technical Manuals
Department of the Army	TO&E-TDA-CTA	Technical Bulletins
Pamphlets	Training Circulars	Supply Bulletins
Department of the Army		
Circulars		

*Categories are differentiated on the basis of degree of illustration inclusions.

**Categories do not total to 100%, since small numbers of other publication types were not included.

Analysis of Table 5-1 data points up two areas pertinent to micro-publishing conversion. First, category I, although it is only 9% of the total expenditure, represents over \$10 million in costs. AR type publications are largely straightforward text without graphics inclusions and as such are natural candidates for any micropublishing technique. Second, category III at over 55% of the annual publications cost is a prime candidate for conversion consideration, if the material economically lends itself to the technique. Since TM type publications contain over 51% graphics pages, the technique must understandably have a higher level of sophistication than that used for ARs.

e. The second important consideration is publication volatility; that is, how many documents have changes over their life-time, and how often or how extensive these changes are over a year's time. Empirical extrapolative data indicates 37% of all job requests for first quarter 1975 were changes to original documents and that the average number of pages per change was 29 (an average document length of the project sample is 75 pages). The foregoing analysis and paragraph 5-2d defined the range of publication candidates for conversion, that is, the WHAT to micropublish and in what anticipated breakdown: 9% AR types, 23% FM types, and 55% TM types and 13% other types.

f. WHEN to micropublish is partially derived from this same data base. Obviously, to convert merely for the sake of conversion is not economical. But, since original document creation has high cost

whether it is produced for hardcopy or microfiche, this area does become a prime candidate for WHEN to micropublish documents. Based on the empirical data, 37% of annual job requests are for changes to original documents. The high costs for changes, as previously noted, occurs because of the possible "cascade" effect which results when additions or deletions change the location of text on successive pages. The WHEN to publish, therefore, further refines the WHAT to publish range of conversion candidates to those ARs and TMs which are new publications and those which have changes in excess of 10% of the total pages.

g. The WHAT and WHEN of micropublishing have confirmed the two mandatory capabilities of a system design. The system must be so designed that it will be able to handle the full scope of illustrative material, and expeditiously handle the problems of changes to original publications. With this criteria established, the "HOW" to micropublish can be addressed.

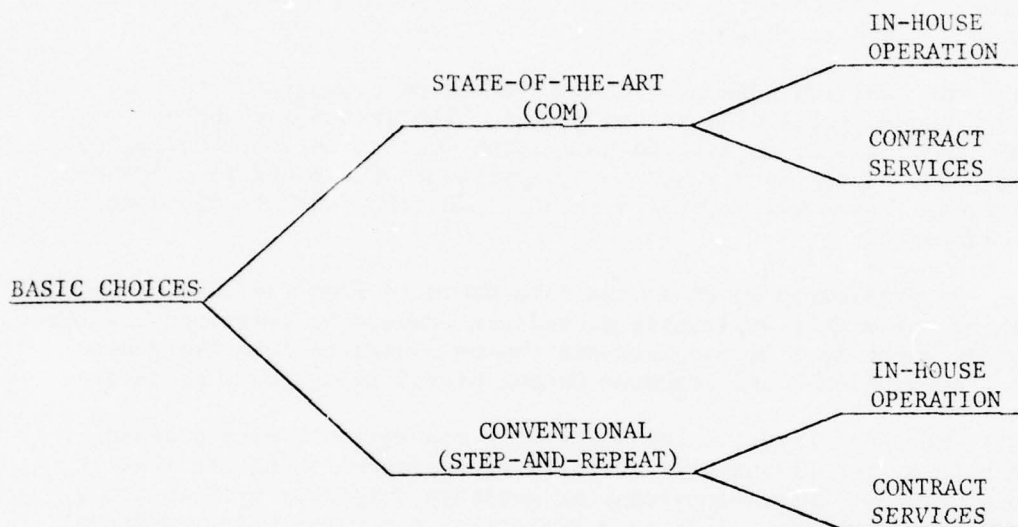
h. As previously noted in the data captured from the current micropublishing world, the applicable microfiche production techniques of the technology which meet DA requirements can be separated into two general fields: conventional and Computer Output Microfilming (COM) processing.

(1) Step-and-Repeat - the older more conventional micrographics approach to micropublishing is actually micro-republishing, in that it microphotographs camera-ready copy or hardcopy originals by means of a step-and-repeat camera. This is a photographic process which advances the film in discrete increments. Each individual frame (page) is sequentially recorded on a microfiche (4" x 6", 105mm film). Today's level of development has highly automated and accelerated the thruput of this technique.

(2) COM - Computer Output Microfilming employs mini-computers to drive a recording camera which also moves the film in discrete increments to successively place each page (frame) onto a 105mm film. Instead of photographing a paper copy, this operation photographs text after it has been displayed on a CRT. As applied to the needs of true micropublishing, this technique requires extensive software programming and hardware innovation beyond the simple COM applications that are used as substitutes for off-line computer printers. In order to merge associated illustrations with text, an even higher level of software/hardware is required.

i. Having defined the two possible approaches in equipment/systems for prototype consideration, a decision on who should operate the selected system and where it should be done was made. Two basic choices were possible. The operation of the prototype could have

been either by service contract at a vendor's plant or by IMPACT personnel at an in-house location. IMPACT's decision was determined through the "New Start" exception process, per AR 235-5 (see Appendix K). Simply illustrated, this diagram depicts the sequential process of selection.



To resolve the first leg of the decision process, the following matrix was employed.

TABLE 5-2
SYSTEM COMPARISON

<u>PROTOTYPE REQUIREMENTS</u>	<u>PROTOTYPE ALTERNATIVES</u>	
	<u>COM WITH ILLUSTRATION MERGE</u>	<u>CONVENTIONAL STEP-AND-REPEAT</u>
Maximum Thruput Rate	X*	
Easiest Change/Update	X	
Flexible/Modular Equipment	X	X
Lowest Production Cost	X	
Compatible GPO Linotron (photocomposition)	X	
Fewest Operating Personnel Requirement	X	
Lowest Equipment Cost		X
Minimum Number Production Steps	X	

*"X" markings indicate comparative advantages.

j. A discussion of each requirement, item by item follows:

(1) Maximum Thruput Rates. As has been noted, all of the table's decisions are based on the publications defined in the WHAT and WHEN to micropublish; that is, original copy and copy with significant changes to its original form. Thruput is defined as all operations after receipt of error-free copy and/or change information from the proponents. For conventional methods, this includes the extensive preparation required to produce camera-ready copy: typing, pasting, printing, composition and photography. COM's procedures simply place text data on mag-media for composition through the COM micropublishing programs and merge this input with prepared illustration slides when recording on film.

(2) Easiest Change/Update. This is a function in which the computer can far surpass the conventional step-and-repeat process. A single paragraph added to a document can produce a "cascade" effect upon following pages by down-shifting all data. Conventional systems must perform the full range of operations to reproduce the involved pages for re-photographing. A micropublishing COM device reorganizes its data base through console commands or through revised magnetic tapes and it is ready for reprint of the text material.

(3) Flexible/Modular Equipment. This states that the prototype must be able to change its subsystem to test various equipment or processes. The conventional procedures can change cameras for various film style experimentation; but the COM system can change concepts. That is, it can readily alter its input or front-end system, e.g., from keyboarding to scanning OCR devices. It could likewise alter its storage systems from disk to tape to video-disk - as the technology develops.

(4) Lowest Production Costs. This choice was based on conventional vs COM production as shown below:

TABLE 5-3

COMPARATIVE DOCUMENTATION*
PRODUCTION COST**

<u>PRODUCTION MODE</u>	<u>COST BREAKDOWN</u>		<u>TOTAL</u>
	<u>PREPARATION</u>	<u>PRODUCTION</u>	
Conventional (Step-and-Repeat)	\$216,800	\$400	\$217,200
COM (Compositional Type)	\$ 96,000	\$50,000	<u>\$144,000</u>
		Difference	\$ 73,200

*10,000 pages documentation
51% illustrated pages

**Industry Averages reported in 1974 Aerospace Industries Association symposium: "Automated Preparation of Publications, an Emerging Technology".

(5) Compatible with GPO Linotron and Other Photocomposition Equipment. The magnetic tape output of the COM front-end subsystem can be programmed as input to both the Mergenthaler Linotrons and other more common photocomposition equipment. This permits a choice of optional output for in-process user discrimination, that is, an end product choice of hardcopy or microfilm as needed.

(6) Fewest Operating Personnel. Conventional step-and-repeat systems require the same extensive manual preparation as hardcopy printing. This is performed internally through the computer software in a COM micropublishing system, resulting in need for fewer personnel.

(7) Lowest Equipment Cost. The dollar comparison below indicates the general economic advantage of a conventional system over a COM micropublishing system.

TABLE 5-4

COMPARATIVE EQUIPMENT COSTS

	<u>COM</u>	<u>CONVENTIONAL</u>
<u>INPUT:</u>		
Phototypesetter	-	\$ 6,366*
Print Preparation		
Mini-Computer System	\$19,647*	\$19,647*
<u>PRODUCTION:</u>		
Automated Step & Repeat		
Microfilmer	-	\$19,600*
COM Recorder	\$87,084*	\$ -
Processors	\$ 4,800*	\$ 4,800*
Inspection	\$ 850	\$ 850
Miscellaneous Items	\$ 480	-
<u>FICHE DUPLICATOR:</u>		
(Inspection)	\$ 1,586	\$ 1,586
	<u>\$117,147</u>	<u>\$52,849</u>

*Leased Items

(8) Minimum Production Steps. As evidenced by the following comparison, the COM micropublishing system requires half the production steps of the step-and-repeat operations.

TABLE 5-5
PRODUCTION STEPS

<u>OPERATIONS*</u>	<u>COM</u>	<u>SYSTEM</u>
		<u>CONVENTIONAL</u>
Keyboarding Final Copy	X	X
Editing and Final Proofreading	X	X
Typesetting		X
Art Preparation/Inspection	X	X
Page Layout and Strip-up		X
Art Proofing		X
Final Text/Graphics Organization; Collate Master		X
Preparation of Table of Contents and Index		X
Prepare Title Header		X
Expose Master Microfilm	X	X
Develop and Inspect Master Microfilm	X	X
Produce Distribution Copies	X	X

*(Commencing with receipt of Proponent's Final Draft)

k. This data supported the original decision to go state-of-the-art using a COM-based prototype micropublishing system. Delivery, price, lease periods, training, and service were discussed with interested manufacturers and no problems were anticipated in these areas. During the reconnaissance phase, a thorough investigation of the on-going COM world of micropublishing was performed. The users listed in Table 5-6 have indicated that both thruput and cost per page of production are substantially reduced from former operations.

TABLE 5-6

COM INSTALLATIONS

<u>PROPONENT AND LOCATION</u>	<u>EQUIPMENT MANUFACTURERS</u>	<u>INPUT TO COM</u>	<u>PRODUCT</u>
TRUMP - Navy Jacksonville, FLA	III	Grafix I Scan Plus Merge Illustrations	Technical Manuals
NPPSO - Washington Navy Yard	700 Data Gould	Computer Output Tape (Text Only)	Navy pub- lications
Southern Bell Telephone Atlanta, GA	III	Computer Output Tape (Text Only)	Directory Assistance Data
DDSI - Los Angeles, CA	III	Scanner and Keyboard	Consultants Contract Services
Lockheed Missiles & Space Sunnyvale, CA	III	Computer Tape and Merge Illustration	Technical Manuals Engineering
Lockheed - Burbank, CA	Stromberg Carlson - Data Graphics	Computer Tape and Slides	Technical Manuals
Singer Simulation Products Sunnyvale, CA	Singer	Scanner	Manufacture and Services
Information International Incorporated (III) Culver, City, CA	III	Scanner and Computer Tape	Equipment- Service- Consultants
NASA - WASH DC	Datagraphics	Computer Tape	Manuals
DIA - WASH DC	Datagraphics	Computer Tape	Intel Pubs & Reports
USAF ALC & ALC - DAR Washington, DC	Datagraphics	Computer Tape	Air Force Publications
Chrysler	III	Keyboard and Computer Tape	Parts Catalog

"Qualified" (note comments column) savings surveys by several users show a substantial cost reduction when converting to COM production.

TABLE 5-7

COM-BASED MICROPUBLISHING SYSTEMS
STUDIED BY "IMPACT"

<u>SYSTEM IDENTIFICATION</u>	<u>PERCENTAGE OF SAVINGS OVER PAPER PUBLICATIONS</u>	<u>COMMENTS</u>
USAF Automated Technical Order System (ATOUS)	62%	Estimated after full implementation
US Navy Technical Review and Update of Manuals and Publication Program (TRUMP)	87%	Based upon current system operation
Southern Bell Telephone Co.	85%	For directory indexes
Lockheed Missiles and Space Co.	25%	Total Production Cost Savings over a Linotron/FR 80 system
MISUR (DDSI)	34%	Over conventional step-and-repeat camera system

1. Having resolved the choice of system design, the second leg of the decision process was addressed. Using the following matrix, the selection was made based on whether in-house or contract services had the most advantages.

TABLE 5-8

<u>TEST OBJECTIVES</u>	<u>TEST ALTERNATIVES</u>	
	<u>IN-HOUSE</u>	<u>CONTRACT SERVICES</u>
Hands-on Learning Experience	X	
Detailed Cost Data Collection	X	
Microform Format Experimentation	X	X*
Determine Most Effective Equipment Utilization	X	
Develop Maximum Thruput Rate Methodology	X	
Determine Personnel Requirements	X	

*Marked Cost Increase

These test objectives were successively evaluated per the following discussion.

(1) Hands-on Experience. This knowledge would be required for later transfer to an operational system. It obviously could not be acquired through the contract services alternative with the inherent restrictions of unions and/or the proprietary operational information of the service concerns.

(2) Detailed Cost Data Collection. Although project team members might observe contractors' operations - even timing (stop-watch) some operations - contractors do not permit access to their actual cost breakdown, and any profit factor with its sunk costs, R & D and recovery efforts can have a significant influence on charges to customers. Only in-house operation would give complete and accurate data.

(3) Microform Format Experimentation. Again an obvious conclusion - requests for work from service contractors must be well defined at the time of contract awards. In-process changes are new costs, and very expensive when requested from contractors.

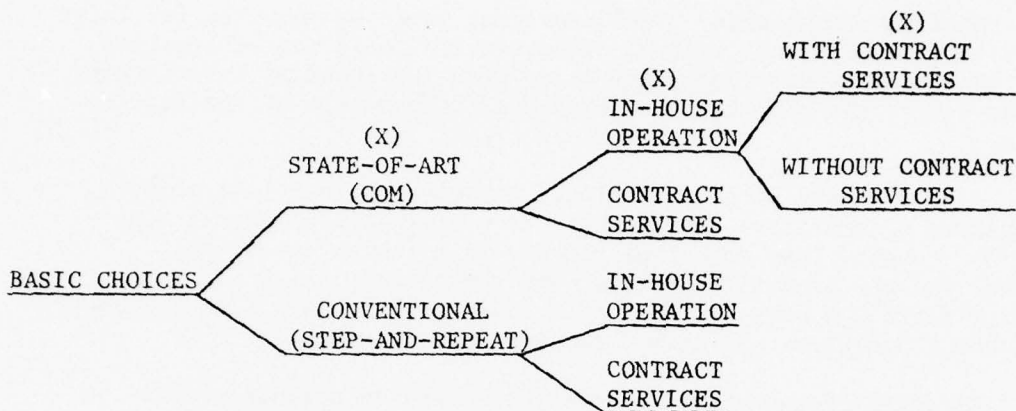
(4) Determine Most Effective Equipment Utilization. There is no economical way to alter a given contractor's operations. Again, only in-house control would permit the necessary variations.

(5) Develop Maximum Thruput Rate Methodology. Hands on control permits experimentation and recording of activities. These data are not available through contractors' service.

(6) Determine Personnel Requirements. Over an in-house prototype's life this will be fall-out data. It is not possible to compare a contractor's personnel, configurations, and historical limitations with the scope of the federal personnel structure.

m. During the foregoing two-stage process it was recognized that two other choices existed: pure calculations and a hybrid operation. The calculation option is mentioned because it is a vendor's method of determination, but it is based on quoted facts and under ideal conditions and therefore is of marginal value for data collection and comparison. The second choice, a hybrid of in-house operations plus contractor services, is a natural option, which becomes apparent as other options are evaluated. When this last option is included in the list for comparison a close choice between COM-in-house and a hybrid operation is apparent. When the advantages of a hybrid for prototype operations are considered, the inherent merit becomes obvious. Contract services can augment both the input subsystem and the final output operations. This assistance could significantly affect total prototype thuput and permit more production activities over its life. Although the hybrid choice might enhance the project's prototype operation, it would reduce its costs.

n. The foregoing decision process reduced the system selection to the following:



X=Final System Selection

o. Instructions from TAG following IMPACT's 17 February 1975 Decision Briefing, JCP approval, and MICRODIS approval, supported this decision. (see Appendix L).

5-3. Final Design.

a. System. The most prominent of the selection characteristics of the final design was its independent component feature. The three components or functional subsystems (print preparation, film recording, and film processing) were discrete physically as well as functionally. This feature permitted substitution of other designs or versions as long as the input/outputs (I/Os) were compatible. IMPACT's final configuration was a hybrid system employing in-house print preparation and film recording while performing its film development through private contractors. The film development system was not included as an in-house operation because of the short life of the project, which did not warrant the set-up expense to handle water supply, waste drainage and the venting of noxious gases. This subsection will briefly discuss the overall system without any detailed delineation. A technically oriented detailed description of each subsystem will be given in the next subsection.

(1) The front-end of the IMPACT micropublishing system was a computer based print preparation subsystem. Its function was to convert author input into machine readable form. This output was the input for the next subsystem, the COM recorder. By means of input stations, which can be I/O typewriters, CRTs, OCR devices, magnetic tapes and disk

packs, it converted, edited and outputted compatible 9-track tapes for the next operation. In addition, the print preparation tasks included the production of negative film slides which contain any associated graphics. This was done with special camera setups to properly size and locate any illustration on a page for subsequent merge with text.

(2) The next subsystem was a COM device which was programmed to output microfilm from compatible tape inputs and illustration slides. The software which controlled the subsystem was capable of producing style, line lengths, page/column sizes, character sizes, right/left justification, and could perform hyphenations.

(3) The last subsystem accepted the undeveloped film from the COM recorder, developed the microfilm/fiche masters, and produced quantity duplicates.

b. Subsystems. The three components comprised the subsystems. Print preparation and film recording are herein discussed with regard to design in terms of their hardware-software characteristics, and film processing is discussed by a review of the awarded contract's specifications.

(1) Print preparation can be further separated into text processing and photocomposition. Text processing, including data input, editing and formatting, used the hardware and associated software provided by a particular manufacturer who met IMPACT's design concept. In most cases the majority of the hardware elements consisted of standard off the shelf items, such as input typewriters and CRTs, but the central control unit and software were unique to the IMPACT requirements. Photocomposition, akin to the compilation step in conventional programming, creates the input to the COM film recorder and must be formatted in a manner recognizable to it. In the case of the prototype system, the print preparation and the film recording subsystems were supplied by different vendors, with the print preparation group assuming responsibility for the interfacing software. The hardware configuration is shown in Figure 5-1. A short discussion of each unit follows.

(a) The central control unit is a mini-computer with a shared logic operating system which allows parallel operation of multi-channel text processing and photocomposition tasks. Its associated storage devices are two disk and two mini-magnetic tape drives. The mini-magnetic tapes may be either system or data tapes. System tapes are used in bootstrap/initial startups, data tapes are used as their name implies. Operation is file oriented, with shuffling, accessing, and storing procedures well documented by the system and simple to use. Text processing software is interactive with the operator, protecting both the user and system from gross errors. It covers the five general

PRINT PREPARATION SUBSYSTEM

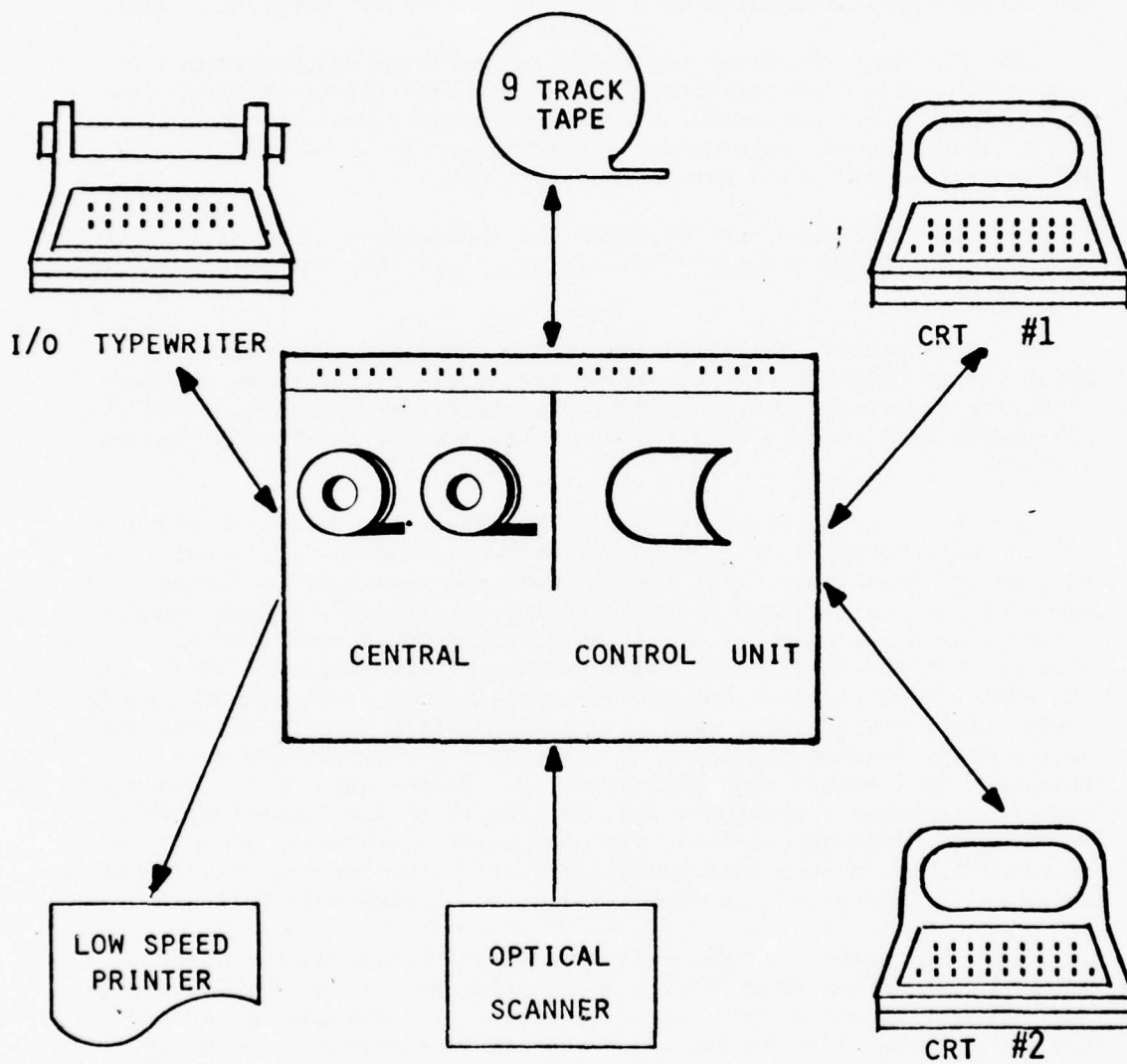


FIGURE 5-1

areas of: filing, editing, printing, formatting and miscellaneous commands. The photocomposition package (PCP) consists of a general automatic hyphenation of words, justification of lines and automatic pagination system with an add-on software portion compatible to the COM film recorder. A bedrock file of basic typesetting commands is provided. From this, users may create special purpose combinations or equivalences called expansions which are applicable to their specific printing needs. When these equivalences and their purported uses can be made identical to corresponding text segments, a document can ideally be used to format itself. The PCP is interactive with the operator providing initialization routines and diagnostic information during job compilation. Multi-user text processing and single user photocomposition are under control of the operating system through its queuing and multi-plexing logic.

(b) The input typewriter and two CRT I/Os provide keystroke input, print-out playback and interactive conversation between operators and the system.

(c) The optical scanner allows for relatively fast inputting of data (approximately one typewritten page per minute), provided that the format of the text is readable by the scanner.

(d) A low speed printer operating at approximately 55 characters per second, such as the I/O typewriter, is used as a means of producing interim printouts, which the CRTs are incapable of producing.

(e) The 9 track magnetic tape can serve as both input and output as shown in Figure 5-1. Final output of the print preparation unit and input data stored on magtape both utilize the drive.

(2) Film recording directly on microframes (16mm or 105mm microfilm) consists of the COM unit interpreting the hung magtapes from the print preparation unit (prepared in a binary language standard data format), providing the fonts and graphics material called for, and positioning the pagination data. The hardware configuration is shown in Figure 5-2.

(a) The central control unit is a programmable mini-computer with an auxiliary disk memory that directs the film recording sequence. An extensive bank of software (library) is provided by the manufacturer which can be augmented by the user in assembly language (essentially identical to that used in most mini-computer systems) and a proprietary higher level programming language. When using the library provided, control is initially under a symbolic error-solving (debugging) program, which brings in (swaps) auxiliary programs from disk storage as required. Control is returned to the basic program by the console operator when he or

M I C R O F I L M R E C O R D I N G S U B S Y S T E M

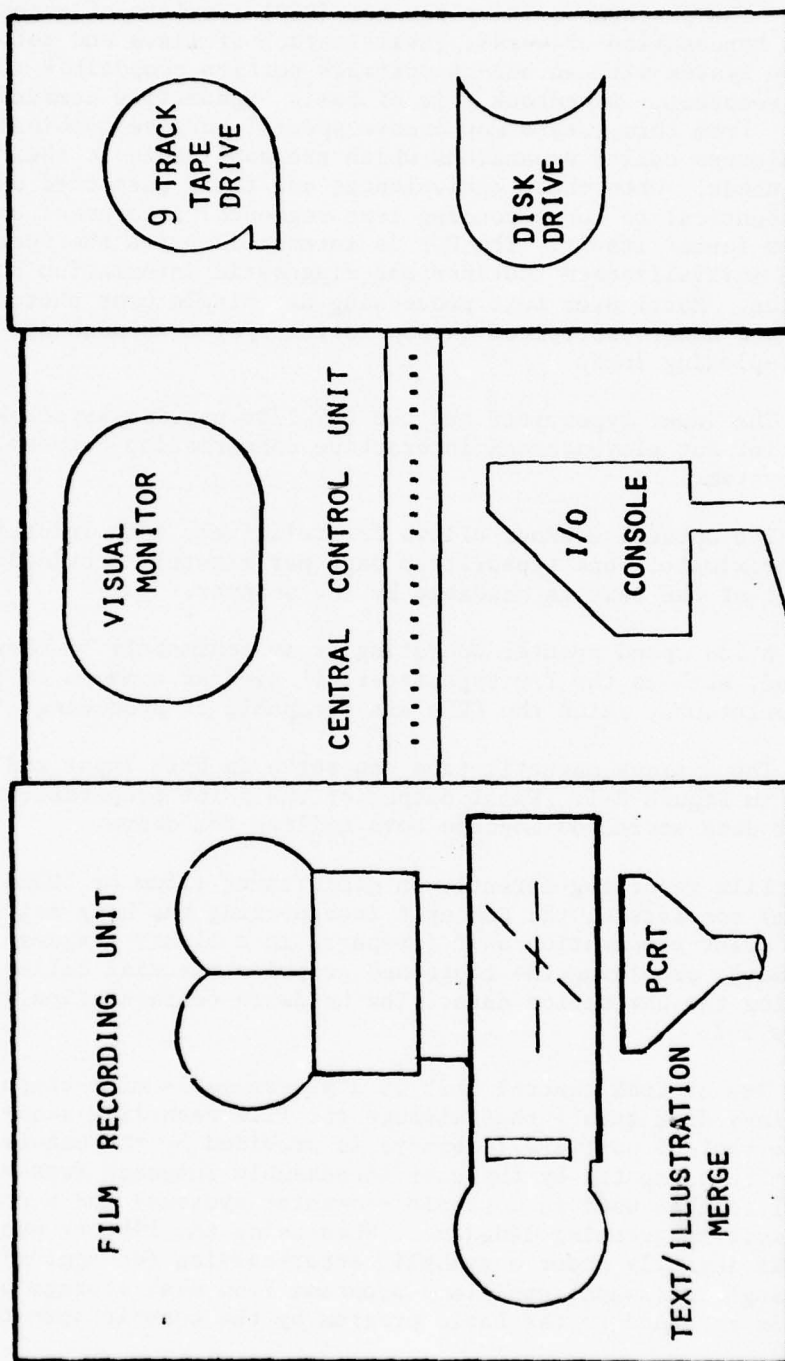


FIGURE 5-2

74

she finishes with a particular auxiliary. Service programs provide means for assembly, editing, auditing and file manipulation. The actual film sequencing control programs, referred to as monitors, are tailored to the data tape from the print preparation unit and provide an interactive method of specifying images per fiche, blocking, title size, row or column orientation, recording unit commands etc., which initialize and control a particular filming sequence. During a sequence, the contents of each page are shown sequentially on the control unit monitor scope. The monitor has on-line storage areas available into which fiche titling and form design programs may be stored. Fiche titling may be entered through the teletypewriter. Forms, previously designed, checked, and using a vector generating and positioning software package, are transferred from disk. Titling and forms enter into the filming sequence automatically without any program interrupts. Merging, requiring insertion of a slide, is handled through a program interrupt and signal to the operator through the teletype to position the slide. When this is done, the operator informs the monitor and the film sequence continues.

(b) A 9 track magtape drive is used to read in the data input text composition tapes available from the text processor. The magtape unit also may be used as an output device to provide for a temporary and permanent storage adjunct to the disk.

(c) A standard teletypewriter is used for control of the system, inputting of user generated programs, and as an output device.

(d) The recording unit contains the actual filming equipment. A range of cameras from 16mm to 310mm hardcopy generators may be interchangeably mounted. The frames to be photographed appear sequentially on the face of a precision high resolution cathode ray tube (PCRT). Light paths from merge slides and the PCRT are combined by an angled pellicle membrane and imaged on the film by a single lens. Character stroke generation is by analog control of a beam device. The spot size of the beam and intensity of both the beam and merge strobe light is controllable by the operator to optimize and compensate for variations in camera, film or developing effects. Operationally the text of a particular frame is generated on the PCRT (together with any forms or merge slide material belonging to the page), and the camera activated. The film position inside the camera is positioned by actuators to conform to the frames being recorded.

(3) Film processing as carried out in the prototype was performed by an outside contractor who handled all phases of processing masters and duplicates with a 24 hour turnaround time for normal work loads.

(a) Microforms provided were masters and duplicates of 105mm fiche and masters of 16mm fiche under Military Standards MIL-M-38748A.

(b) Basic developing was under a full reversal process using equipment compatible to the film recorder.

(c) Duplication was both diazo (negative of master), using blue-black or equivalent duplicates, and vesicular (positive of master).

(d) Handling included individual packaging in envelopes and collating of masters and duplicate sets.

(e) Provide film as required.

c. Cost and Deliveries. Four major contracts were issued for the life of the prototype operation. Two were for lease equipment of the print preparation and film recording packages. The remaining two were service contracts, one for outside film processing and the other for supplemental print preparation.

(1) Delivery schedules were worked out with proviso that the print preparation segment of the system be allowed to lead. The operational life of the prototype was selected to run from 1 April to 30 September 1976. To train personnel and provide a data bank, the print preparation tentative delivery date was set at 1 February. Delivery date for the film recorder was set at 1 April. Both leases were planned to run for six months with on-site training of operational personnel conducted by the vendors. Print preparation and film recorder personnel were ideally interchangeable for back up purposes and the eight weeks lead delivery of the print preparation system allowed key people to attend both courses. Lease prices included maintenance and continuing software support. Over the prototype life, costs were \$25,469.34 for the print preparation unit and \$82,942.00 for the film recorder.

(2) Early cognizance was taken of the reality that print preparation would form the operational limit of thruput. This prompted the award of an additional service contract to the print preparation vendor covering outside conversion of approximately 8000 pages of published hardcopy to magnetic tape - hung-ready and compatible to be inputted to the film recorder for alphanumeric text involved. Costs for the contract were not to exceed \$22,000.

(3) A service contract for film processing, as discussed above, was let at a cost not to exceed \$21,460.

5-4. Product Definition.

a. Type of Input. Inputs were selected so as to be representative of a large portion of the scope of DA publications, influenced largely by the profile of categories and volume of documents resulting from the data capture and reduction study covered in Chapter 2. A prepon-

derance of the selections were Army Regulations (ARs) and Technical Manuals (TMs). Other typical selections were Field Manuals (FMs) and a Depot Maintenance Work Requirement (DMWR). Documents, in most cases, had already been published and were available in final form. This allowed the usage of existing typesetting formats but imposed the restrictive objective of trying to create a mirror image of the existing hardcopy.

b. Method of Input. Input methods were chosen so as to provide adequate background data in defining the parameter coefficients of the costing mathematical model, explore the input hardware, and to gain a working knowledge of the effects on thruput caused by system downtime. Inputs therefore, were created by: keystroking, using the I/O typewriter and two CRTs; OCR-ready hardcopy pages typed in prescribed formats; data mini-mag tapes in defined formats; and data on 9-track magtapes produced by other systems that require reformatting before transferring to the print preparation disks.

c. Types of Output. Outputs of a micropublishing system are the finished master fiche, the required number of duplicates, and archival records for future changes and reprint usage. In a prototype system the same objectives are present except that fiche production is more experimental than finished. The most important output of a prototype system is operational data. This data includes records on equipment downtime, the type of training necessary and the type of personnel required to run the system, and records of work quantity measurement selected so that they may be extrapolated into future production type systems. Data capture methods are discussed in Chapter 6 which covers prototype operations.

5-5. Personnel/Training.

a. Operational personnel as conceived for the prototype included general supervision by the project director, an operations research analyst to select and define the data capture methodology, a computer specialist and two console operators to operate the three-input-station print preparation subsystem and another computer specialist whose responsibility was the film recording unit. During the life of the prototype, the personnel were used essentially as described.

b. Training programs were conducted on-site by the vendors of the print preparation and film recorder subsystems. A prescribed staggered delivery schedule made it possible for the computer specialists to attend both courses and serve as each other's backup.

(1) Print preparation training did not follow a strict training schedule as far as course layout was concerned. It was carried out by several instructors on a more or less "as needed" basis. The length

of the course was approximately 160 hours. The first part of the course was given with only a portion of the hardware delivered. It included operation (startup, shutdown, usage of tape drives, etc.), file manipulation and the usage of text editing commands, the second part of the course, given with the full complement of hardware in-house, covered preparing a job for, and the operating instructions required for use of, the photocomposition package. Primary emphasis was on command mode operation that covered the definition and usage of the text formatting implementation library. Equivalences of combinations of these commands, called expansions, were covered in detail. Libraries of commands and selected expansions were furnished by the vendors. The creation of special purpose user oriented expansions was also stressed.

(2) Training for the film recorder unit, a two week course given on-site after delivery of the hardware, followed a more rigorous schedule and covered both theoretical and hands on operation of the equipment (plus some experience in writing special purpose programs). The first week of the course covered the operating system, using a higher level language provided by the vendor for text operations, character manipulations, and hands-on operation. The second week covered specific customer needs, the software library, and the creation of programs not supplied by the vendor. The last phase was the checkout of sample programs written by the students and a review session.

5-6. Installation Considerations.

a. Environment. Environmental requirements were dictated by the requirements of the film recorder. Humidity boundaries in the facility were maintained from 40 to 60% to avoid static electricity problems. Levels at 35% and below could cause serious problems in mag tape slippage and sticking. Stipulated temperature ranges were between 59 and 78 F. The system was occasionally operated at slightly higher temperatures up to 85 degrees with no observed deleterious effects.

b. Wiring. Power sources were three dedicated 115 volt thirty amp lines. No special provisions were made for voltage variations and no problems resulted during the prototype operation because of power variations. Subfloor cabling to inter-connect the print-preparation unit was laid by the vendor in existing conduits. Cable lengths were in all cases less than 20 feet. No problems were encountered.

5-7. Contract Processing.

a. Procedures. The four main contracts involved in the prototype's life cycle were for the lease and maintenance of the print preparation and film recorder hardware and software components, the outside prepara-

tion of machine-readable input (to the film recorder) of typical publications, and lastly a service contract for film processing. As there was only one microfilm recorder on the market that offered the graphic merge feature, the contract was sole source. Hardware and software specifications plus the requirement of a short lease for the print preparation package, after a market survey and series of contacts, indicated only one company that could meet IMPACT's requirements, again providing sole source justification. Outside preparation of text to provide direct input to the film recorder was again, of necessity, sole sourced to the print preparation vendor since he had written, and was responsible for, the software interface between the print preparation and microfilm recorder units. The service contract for film preparation was open for bidding with several vendors submitting proposals.

b. Problems. Problem areas encountered were primarily with the print preparation system. Late deliveries of two video display typing stations, optical scanner, and tape drive were overcome by extending the life of the lease. Late delivery of the PCP software package interface to the microfilm recorder was more serious as it extended the debugging and training period into that period which should have been applied to production time. No deliveries were made of any prepared ready-to-run tapes (the third contract discussed) during the prototype life. The contractor made a serious effort to apply corrective measures, and cooperated as much as possible by providing telephone backup and several site visits by his computer analysts. However, underestimating the work load involved in vendor software preparation, plus inability to let the schedule slip because of milestone requirements and the use of the other leased equipment created drawbacks. A large part of this vendor imposed problem was compensated for by greater personal effort on the part of IMPACT personnel.

5-8. Summary.

a. The preceding paragraphs in this chapter have covered a great deal of material which is essential to an understanding and description of a micropublishing endeavor of this magnitude. Extensive investigation and preparation was undertaken in order to arrive at that point where it was decided that COM based micropublishing could offer a new method in the production of Department of the Army publications.

b. The WHAT, WHEN and HOW of micropublishing described earlier in the chapter illustrate the great potential awaiting the proper choice of a prototype. Following the decision process described in paragraphs 5-2 and 5-3, it was evident that IMPACT was addressing a new frontier of publishing. The prototype's particular grouping of components, operated on an in-house basis, has never previously been assembled to determine if print preparation and film recording could efficiently produce publications on microfiche.

c. The final design paragraph and its accompanying illustrations of the micropublishing subsystems provide a depth of detail beyond that needed by casual readers. This intensive description of component parts can provide a road map for those whose interest goes beyond the prototype stage.

b. Since a prototype is far more than the sum of its hardware and software components, the latter portion of the chapter deals with the product itself; the personnel qualifications needed to operate such a configuration; the simplicity of the physical site; and the experience gained in administering the contracts which make such a configuration possible.

CHAPTER 6

PROTOTYPE MICROPUBLISHING OPERATIONS

6-1. General.

a. IMPACT's prototype micropublishing system was operational at the Forrestal Building from 1 April through 30 September 1976. It encompassed and explored the most important segments of publishing from author input to multi-copy duplication of the finished product. Publications for input were selected to closely approximate those of the real world DA publishing system. The design of the prototype was such that it allowed full analysis, either separately or as a total system, of the three micropublishing production segments: print preparation, microfilm recording, and film processing/quantity duplication. Prototype milestones over the six month experimental operation are shown in Figure 6-1. This chapter covers a detailed description of actual day-by-day operation of the total system and its components, a description of data gathering techniques and a discussion of the results of the data analysis. Due to delays in component deliveries and receipt of compatible converted data from a service contractor, the emphasis on data gathering and cost determination was increased and the use of the prototype to produce completed microfiche was lessened.

b. Paragraphs 6-2 and 6-4, on operations and observations, are identically structured and necessarily detailed. The narrative and system diagrams of paragraph 6-2c alone, will provide adequate continuity in abbreviated form. A cost benefit analysis, paragraph 6-5, concludes the chapter.

6-2. Operations.

a. Total System. The total system was operated to produce a data bank of production records and create in-house expertise in hardware, software and general micrographics production. Because of its tri-modular design the overall system could be operated in several ways (depending on the initial input entry point) all serving to implement the operational objectives. Complete thruput cycles for publication production have error-free author submitted copy or an archival tape as input into the print preparation component. Partial thruput cycles were inputted through the microfilm recording unit in the form of prepared ready to run tapes. Both of these cycles in most cases required graphic data in the form of prepared plastic merge slides and stored subroutines which defined the forms used in the particular document. In this context, forms can mean bordered information or can be as complex as line drawings. A third type of cycle is one where entry is made directly into the film processor to duplicate an existing document on master fiche.

PROTOTYPE MILESTONES

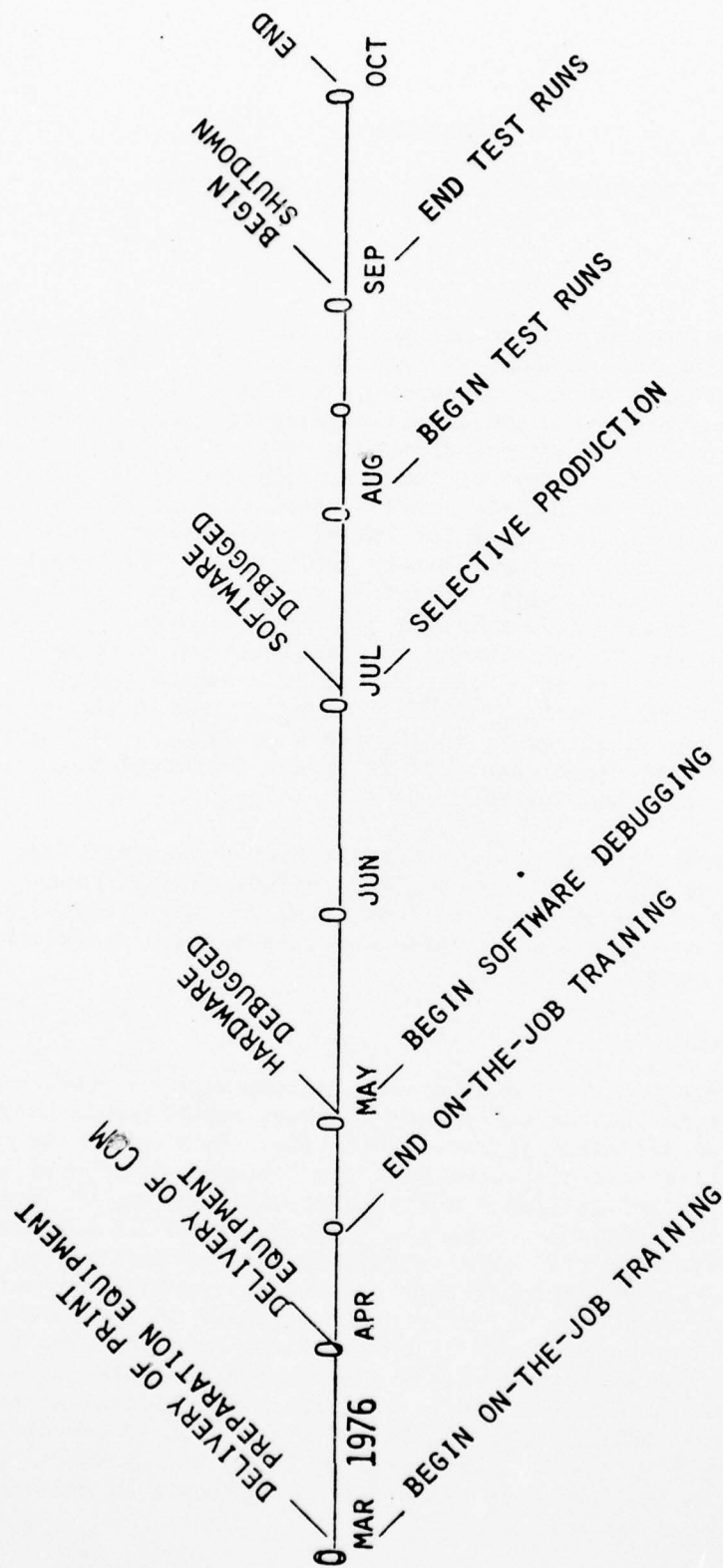


FIGURE 6-1

b. Subsystems.

(1) Print Preparation.

(a) The print preparation subsystem was staffed by one computer specialist and two print editing specialists, each of whom served as console operators and had hands on familiarity with the equipment, its operating system, and the text editing/photocomposition software provided by the vendor.

(b) The first step in print preparation is transferring the text into disk storage using keystroking, OCR or magtape as inputs. Key-stroking through a CRT or input typewriter station creates the least number of complexities but it is time consuming and significantly lowers system throughput. Magtape is the most efficient input means, provided that the tape can be read by the system and formatted easily. Commands from outside print preparation units that must be modified or removed entirely, greatly increase operating times. Correctly formatted OCR input provides the most practical input form as it can be author prepared off-line and inputted almost as quickly as the ready to run magtapes. Operationally it was found that the only limitation to OCR scanner input was the rather sensitive calibration requisites of the equipment.

(c) The text which the operator has input is filed on disk. It is then played back and edited for spelling and omission errors. When this is completed, formatting commands are next entered into the text by the operator. A significant operational limitation of the prototype print preparation package was that the console operator using the formatting software had to wait until the file was compiled, filmed and developed, before seeing any detailed results of the program.

(d) With editing and formatting completed, additional commands for flashing forms and merge slides are inserted into the text. The package is then compiled and transferred to 9 track tape in a standard data format that can be read by the COM film recorder.

(2) Film Recorder.

(a) The film recorder component was the responsibility of a second computer specialist. Before starting any filming sequence a check is made to see that required fiche titling and any associated forms were available. These were programmed beforehand using vendor supplied software and stored for subsequent use on disk or tape. If merge slides were to be used in the production they were also checked and correctly sequenced.

(b) The next step involves ensuring that the equipment is set up to conform to the options selected. This includes selection of film size, reduction ratio, row or column filming sequence, etc. During the prototype's operation a 105mm camera was used that was capable of producing fiche with reduction ratios of 24:1 and 42:1. Changes in reduction ratio can be made by the console operator through monitor software commands and insertion of an appropriate indexing template into the camera control unit. Software options controlled the row or column recording sequencing of pages (frames). IMPACT's design permitted the operator to quickly change over to 16mm filming by using adapter attachments and separate film magazines. Use of 16mm film provides higher and more compact storage and dollar savings during an experimental phase.

(c) As the filming sequence proceeds, little intervention is required except for the manual insertion of merge slides. Errors in the data tape can cause a program interrupt; but several layers of error diagnostics are available (ranging from a perfunctory one word flag on the teletype to reading the problem section of the tape through special software interface filters that provide more detailed diagnostic messages). The diagnostics plus any visual help picked up from the monitor scope by the COM console operator during the filming sequence are returned to the print preparation subsystem for correction.

(d) After an interrupt caused by an error in the data tape a run may be restarted or aborted. Within the prototype's limits, what appears on the developed fiche was the best diagnostic tool. As required, film developing on these diagnostic type runs was done in-house by IMPACT personnel (rather than by the service contractor) to reduce time of feedback of information to the print preparation programmer. This work was done on a film developing unit made available through The Surgeon General's Office. Although this output was limited to positive masters it was quite adequate for the intended purpose.

(e) When a filming sequence was successfully completed, an end of file notation on the data tape repositioned the film in the camera for new processing.

(3) Film Developing and Processing. Film processing of master microfiche was done by an outside contractor. Development of finished masters, preparing illustration merge slides, and providing diazo and vesicular duplication of master fiche was provided by the vendor. Turnaround time for the service was generally twenty-four hours.

c. Systems Diagrams.

(1) Print Preparation Module, Figure 6-2. This subsystem accepts error-free copy and inputs it to its computer via typewriter, CRT, OCR or magtape. Playback to the CRT allows editing and formatting of the text. The module's final output is on magtape which is software compatible to the COM recorder input. The bottom of the schematic shows the separate work flow path of merge slide preparation. All artwork is photographed at a reduction ratio dependent on final size and the COM camera scale factors and then mounted on properly registered plastic slides.

(2) Film Recording and Processing Modules, Figure 6-3. The film recorder accepts the tapes from the print preparation subsystem and the associated illustration merge slides to produce titled microfiche at 24:1 and 42:1 reduction on either 16mm or 105mm film. Routines for form design and titling are prepared beforehand and stored on-line before the appropriate filming sequence. Film processing, performed by an outside contractor, is shown on the two systems diagrams, Figures 6-2 and 6-3, as merge-slide preparation and microfiche duplication.

d. Production Quantities. Because of the selective method of prototype operation, quantities are more realistically expressed as component thruputs rather than finished document output. An indication of the magnitude of this activity is the number of masters produced by the film recorder, and recorded in the unit log. Including the majority of experimental fiche (but excluding 16mm recordings), 1,015 master fiche were recorded. Diazo and vesicular duplicates were made of selected COM produced master fiche and of the masters used in the user field test by a step-and-repeat microfilming process. Taken from contractor invoices, these amounted to 53,116 copies over the life of the contract. These volumes were handled with relative ease by the small staff conducting the prototype operation.

6-3. Data Capture Procedures.

a. Production Records.

(1) Job processing for both the print preparation and COM recording components were documented daily on a prepared production form. The form was designed to allow record keeping of all job phases, e.g., the peripherals used, work quantities and time expended on particular job phases. The form was not meant to serve as a time sheet but rather as a time history of productive portions of a particular job segment. Long debugging phases of particular jobs were not recorded except as remarks or observations. Accurate recording in a prototype operation of a variety of job functions is more important than attempting a progressive optimization cycle on a particular document.

PROPOONENT INPUT

PRINT PREPARATION SUB-SYSTEM

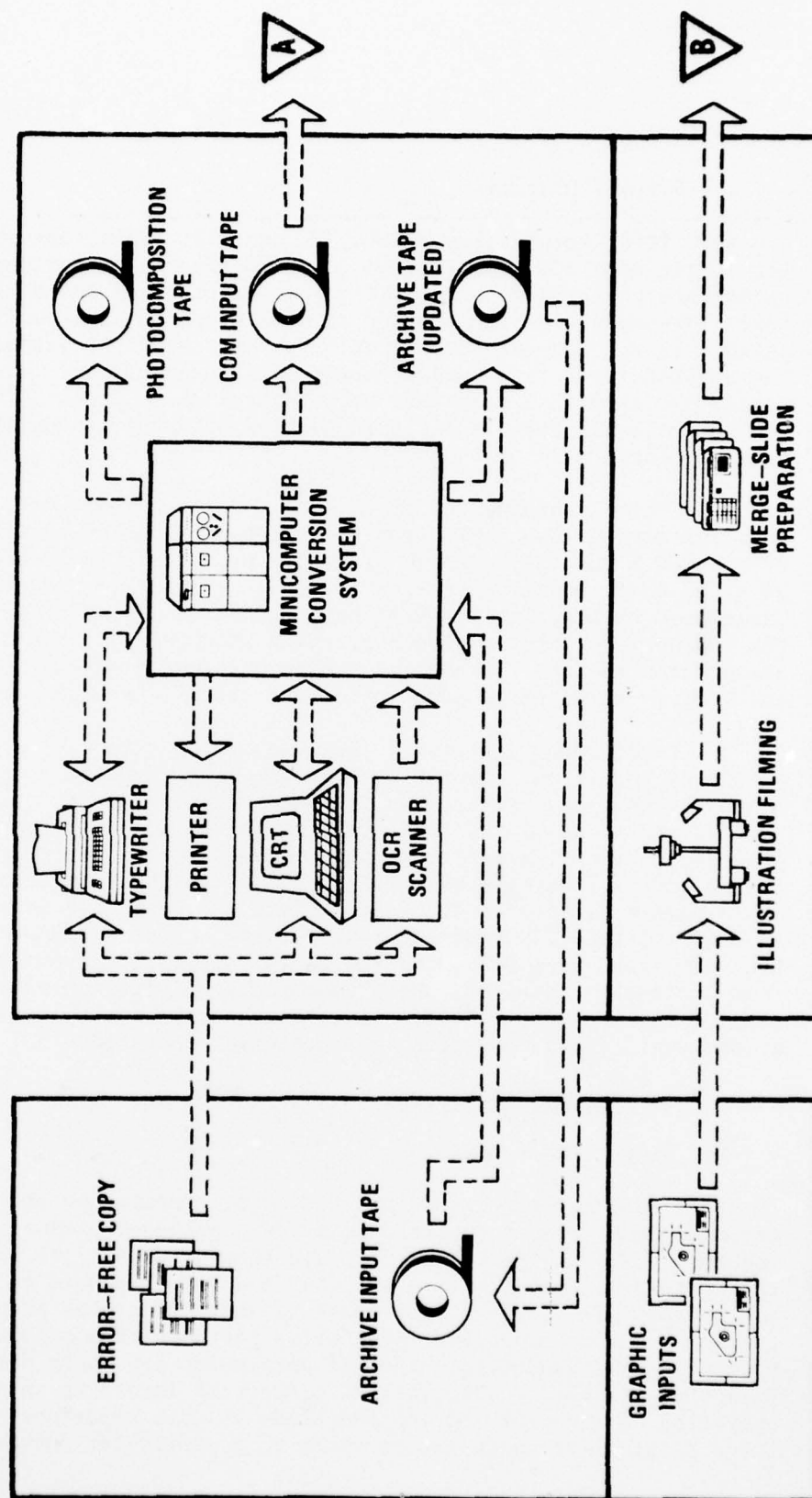
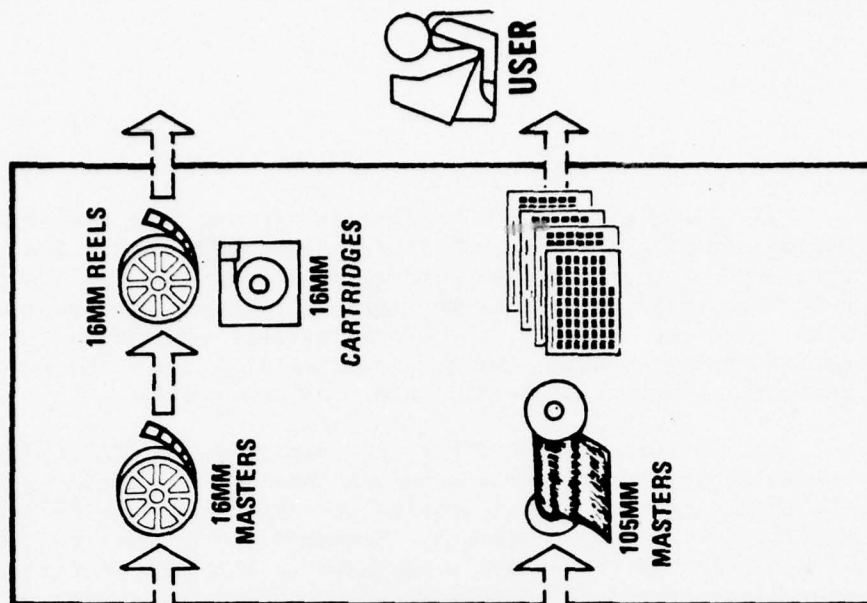


FIGURE 6-2

FILM DEVELOPMENT AND QUANTITY DUPLICATION



MICROFILM RECORDING SUB-SYSTEM

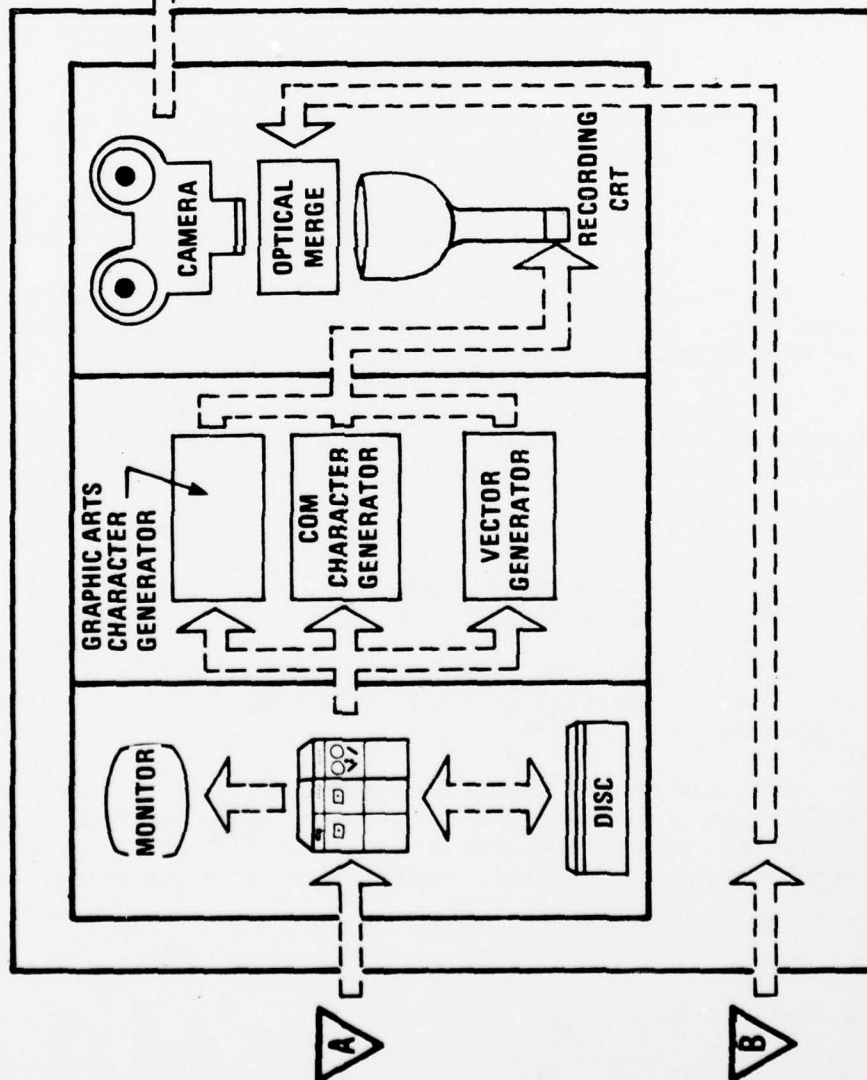


FIGURE 6-3

(2) Terms used in the production account form are selected to define a particular segment of the hardware configuration and job category. A sample of the production account form is shown as Figure 6-4. The upper portion of the form defines the equipment used and identifies the operator, the middle segment identifies the job actions and time used, and the lower section lists the work quantities. Terms which may need definition are covered below:

(a) Preformatting - OCR - text designed for OCR input can be corrected for obvious errors before submission. Arriving documents are single spaced, left justified and typed with an IBM Selectric Courier 12-173 typing element. Mistakes in the text can be corrected with a felt tip pen before submission to the OCR, provided that the prescribed procedure is followed.

(b) Formatting - CRT/OCR I/O Typewriter - The inclusion in the text of a set of typesetting commands, in a language compatible to the shared logic computer software, that prescribes size, font selection, pagination, spacing, etc.

(c) Read Input - OCR - Time required for the OCR to read the typewritten text into disk storage.

(d) Editing - CRT/OCR/I/O Typewriter - Corrections to input text for omissions, typographical and contextual errors.

(e) Programming - COM Recorder - Programming of utilities to supplement the film producing operation and provide diagnostics to help in debugging output of the print preparation tapes.

(f) Form Preparation - COM Recorder - Using forms design syntax software to create vector segment generated forms, storable on a disk library and callable at selected segments of the film producing cycle.

(g) Stripout Shooting - COM Recorder - Filming 16mm microfilm.

(h) Fiche Shooting - COM Recorder - Filming 105mm microfiche, including the input of title.

(i) Merging - COM Recorder - Usually a portion of fiche shooting but it may be regarded as discrete if long series of experimental merge slides are to be filmed.

(3) Analysis of the data captured was done by averaging the results and expressing them in terms of lines per hour of some similar variable. Because the same personnel were used throughout the six month prototype operation, variations in absolute values were not

FIGURE 6-4

PROJECT IMPACT DAILY PRODUCTION ACCOUNT

DATE: _____

PERIPHERAL: ___PRINT PREPARATION SYST. CRT #1 ___I/O TYPEWRITER
 ___PRINT PREPARATION SYST. CRT #2 ___COM RECORDER
 ___PRINT PREPARATION SYST. OCR

OPERATOR: _____

OPERATION/WORK MEASUREMENT: JOB # _____ JOBNAME _____

	<u>PERIPHERAL</u>	<u>MANMINUTES</u>
PREFORMATTING	OCR	_____
FORMATTING	CRT/OCR/I/O Typewriter	_____
KEYSTROKING	CRT/I/O Typewriter	_____
READ INPUT	OCR	_____
EDITING	CRT/OCR/I/O Typewriter	_____
PROGRAMMING	COM Recorder	_____
FORM PREPARATION	COM Recorder	_____
STRIPOUT SHOOTING	COM Recorder	_____
FICHE SHOOTING	COM Recorder	_____
MERGING	COM Recorder	_____
OTHER (specify):		
_____	_____	_____
_____	_____	_____
_____	_____	_____

WORK QUANTITIES:

PAGES INPUT	_____
PRINT PREPARATION	_____
SYSTEM LINES	_____
FORMS	_____
MERGE SLIDES	_____
16 mm FRAMES	_____
105 mm FRAMES	_____
OTHER (specify):	
_____	_____
_____	_____
_____	_____
_____	_____

large enough to necessitate any statistical method of evaluation. Results of the analysis were used in computing throughput levels and costing, and are discussed in detail in Section 5 of Chapter 9 and Appendix E.

b. Hardware Maintenance.

(1) Equipment maintenance records were kept on special forms and in the daily logs. The form was designed to provide data on equipment reliability, contractor response to service requests and effects of downtime on production. Data gathering commenced after initial equipment set up and check out by the contractors.

(2) A copy of the two page form is included as Figure 6-5. The upper portion of the form's first page is used to indicate the particular component and malfunction. The lower portion is used to include response time and effects of the malfunction on production. The second page is reserved for comments. Terms not defined on the previous data capture form and not transparent are defined below:

(a) Tape drive - The mini-magnetic tape drive on the central control unit.

(b) Magtape 9-Tk - The drive on the stand-alone mag tape unit.

(c) Translator - Photocomposition software package.

(d) CPU - The control unit's central processor.

(3) Analysis. Results from the data capture forms and log entries are presented below. Although an attempt was made at analysis, the effects of downtime on production is not clear because of the method of data gathering used in the production cycle.

Print Preparation Module:

Preventive Maintenance Time	- 0 Hours
Downtime	- 114 hours over 6 months.

Film Recording Module:

Preventive Maintenance Time	- 61 hours
Downtime	- 33 hours over 6 months.

Preventive maintenance reduces downtime and if scheduled properly, will not affect production. It also greatly reduces periods where equipment is operating marginally although not fully down.

FIGURE 6-5a

IMPACT EQUIPMENT FAILURE ACCOUNT

1. EQUIPMENT

A. PRINT PREPARATION SUBSYSTEMS

___ I/O Typewriter	___ CPU	___ DISK U2
___ CRT 1	___ TAPE DRIVE	___ TRANSLATOR
___ CRT 2	___ DISK U1	
___ OCR	___ OTHER	_____

B. COM FILM RECORDER SUBSYSTEMS

___ TAPE DRIVE	___ MONITOR	___ CAMERA
___ DISK DRIVE	___ TELETYPE	___ OTHER _____

2. MALFUNCTION: _____

3. DATE/TIME OF MALFUNCTION: _____

4. REPAIRMAN CONTACTED DATE/TIME: _____

5. REPAIR SERVICE START DATE/TIME: _____

COMPLETION DATE/TIME _____

6. REPAIR ACTION: _____

7. DOWNTIME: _____

8. EFFECTS ON PRODUCTION: _____

FIGURE 6-5b

9. OTHER COMMENTS: _____

REPAIRMAN _____

PROJECT OFFICER _____

6-4. Observations.

a. Total System.

(1) The prototype system, as originally designed, performed in excellent fashion for all its prototype applications. Using the tri-modular functional approach proved out its intended objectives. It was possible to vary any subsystem without regard to the total system, thus, permitting precise data capture on each subsystem on a variety of tasks.

(2) The front-end subsystem interfaced with the COM recorder and personnel were able to handle the software complexities of the two non-integrated components. The COM subsystem performed as required with merge of text and graphics recording and produced excellent quality microfiche with comparable "blow-back" quality. The use of service contracts to develop master fiche and produce quantity duplicates was highly efficient in both product quality and response times.

(3) To summarize, the conceptual design was highly successful and at this time no major concept changes are envisioned.

b. Subsystems.

(1) Print Preparation. The prototype front-end subsystem performed all required functions necessary to accumulate accurate production data. But the limited thruput power of the manufacturer's design drastically reduced the product sample size. Equipment service was marginal as evidenced by the downtime records presented in paragraph 6-3b. An analysis of the principal individual components of this subsystem as to relative advantages and disadvantages is as follows:

(a) The typewriter terminal - as a proven I/O instrument was maintenance free. It was slower than the other I/O devices but did offer the facility of being a standby low-speed printer. Any proposed micropublishing system should consider having at least one input station of this type in its front-end subsystem.

(b) CRT I/O Stations. The prototypes two units were generally maintenance free. Operations (original entry, changes, deletions and additions) though not significantly faster in keystroking, were 50% faster than I/O typewriters in all composition tasks. No appreciable eye-strain from using the CRT display screens was encountered after the initial learning period. Since this technique has no provision for hardcopy outputs it does require channeling to a printer device. The front-end computer controlled this peripheral device which was a

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low speed device. Any system which must extensively revise initial inputs should have its input stations in a CRT/printer design mode.

(c) OCR. The device used in the prototype operation was a stripped down version selected on an economic/utility compromise, and was fully dependent operationally on the front-ends central control unit. The device worked very well when it was operating, but downtime was frequent and difficult to diagnose. The technique is exceptionally fast by comparison with keystroke input (approximately 30 times faster). OCR is a natural input technique for micropublishing, but the device should have faster entry and accept more character font types than this model and in addition be controlled by its own mini-computer.

(d) Printer. The printer used in the prototype was addressable from the CPU and any input station. It was slow (55 characters per second) but was adequate as an adjunct hardcopy output for the two CRTs in the prototype.

(e) Tape Drive. The IMPACT front-end tape drive was a constant problem. Its downtime was not acceptable even as a prototype operation, and further, service personnel could seldom make a diagnosis which would discriminate the true nature of the encountered malfunctions, that is, whether it was the device or its compiled magtapes which were at fault.

(f) Central Control Unit. This element was considered to be the biggest drawback to the subsystem's attaining acceptable efficiency. Lack of core constrained the software design which then accentuated two primary areas of unacceptable performance. First, compilation time after any publication text to produce a magnetic tape was not acceptable. A 50 page document required 90 minutes to compile (or nearly 2 minutes per page). Secondly, the equipment/software could not support this compiler and any peripheral equipment simultaneously, which meant that during the extended compile operation - no other equipment, CRTs, typewriters, printer or OCR could be used. Under the circumstances, the central control unit could not adequately service the limited three input station prototype operation.

(g) Disk Drives. These were two single disk units which, as with the tape drives, experienced inordinate downtime and difficulties in problem diagnosis. This component in a full operating system would need to be converted to a standard disk pack/disk drive device.

(2) COM-Recording Subsystem. The prototype's COM equipment performed all prototype requirements. Its cameras, tape drives, disk drives and software met all specifications. Microfiche masters containing text and illustrations were exceptional as microfiche and

acceptable for blow-back purposes. Its thruput times could more than meet the manufacturers claims or IMPACT's requirements. Maintenance service was fast, accurate, and thorough. The manufacturer's preventative maintenance plan was largely responsible for the acceptable 33 hours downtime over six-months operation. The only area of any concern was response to requests for software assistance which could exceed two weeks, but was partially compensated for by telephone assistance which was always available.

(3) Film Development and Quantity Duplication. Master film development and diazo/vesicular duplication services performed by an outside contract service agency were excellent. The task of producing merge slides with mounted negatives was not as successfully handled. Final assemblies of negatives to slides were poorly registered and often of imperfect camera quality. Based on other information from users of this item, prices at approximately \$25.00/slide are much higher than could be achieved in-house.

c. Although the various manufacturers experienced some difficulty in meeting all of IMPACT's prototype standards, it must be considered that the state-of-the-art boundaries were being encroached. Operation of the front-end subsystem, although plagued with early problems, was possible only through the courage and perseverance of the manufacturer and his employees. The observations described were the most significant factor in the development of a proposed micropublishing design described in Chapter 8.

6-5. Cost Benefit Analysis.

a. A cost benefit analysis is by its nature comparative. In this case the comparisons made were between present publishing and several micropublishing configurations. Detailed derivations, discussions of equipment, software and costs may be found in Appendix E. Also discussed in the appendix are alternative methods of producing microfiche that do not use the COM unit, and means to produce paper hardcopy from selected fiche. A summarized presentation covering main trends follows.

(1) In the case of present and micropublishing comparison, the ideal comparison would be on a total system basis spanning author input to final distribution for a large sample of publications. Comparison data being unavailable on the total system, the selected area of analysis was one where present publishing and micropublishing perform the same function - the production of hardcopy in the form of printed documents or film from camera ready input. Job actions considered were originals, reprints and updated reprints. Current HQDA publications operations described in Chapter 2 indicated that the average original document published was seventy-five pages long. The document was

also most commonly a Technical Bulletin, Army Regulation, Technical Manual or Table of Organization and Equipment, with 51% of its contents in the form of graphics.

(2) With the comparison basis thus defined, the prototype system was used to formulate the parameters of a mathematical model to be used in cost calculations, and to gather data under realistic conditions that would define absolute values of the model equation coefficients. Results are presented in the referred to appendix and summarized in paragraph 6-5e.

b. Under realistic conditions, operation of the prototype system indicate a possible thruput of approximately 17,000 average sized original documents a year through the film producing unit. Cost optimization required a high use factor of the film producing unit that was far beyond the capabilities of the rest of the prototype. As the film producing unit chosen for the prototype is the only one on the market at the present time capable of graphic merge, and performed most adequately, most of the effort expended was in optimizing and studying variations of the front-end print preparation component.

c. Data collected on a daily basis from the prototype allowed defining a matrix of parameters for a mathematical model covering costs of fiche production and duplication representative of a number of COM units. Four of these are treated in detail in Appendix E. Two use hardware identical to the prototype, except that the number of I/O stations are increased to twenty-four with allied subcomponents increased proportionally. The first, referred to as an optimum prototype, utilized OCR or magtape input and a high level of editing skill on the part of console personnel. The second, a non-optimum prototype, used keystroked input and less skilled personnel. To complete the analysis, an entirely different front-end configuration referred to as a surveyed system, was analyzed both for keystroked and OCR input. Hardware and software innovations make the surveyed system less susceptible to variations in personnel skill levels. Detailed analysis was limited to the four cases discussed above as it was felt they adequately defined the pertinent boundaries.

d. Production and related costs are dependent on raising front-end throughput and increasing the use factor of the rear-end filming unit. Actual synthesis was limited by the in-house front-end available in the prototype study. The mathematical model allowed realistic hypothetical analysis of expanded systems. However, the limits of realistic linear extrapolation was constrained by the predictability of the hardware configurations. The four configurations treated are considered within linear boundaries.

e. As the rear-end film producing component is the same in all cases, systems differences are constrained to variations in the front-end hardware and necessary personnel. Hardware costs of the front-ends analyzed are similar, ranging from \$135,000 to \$160,000 yearly. Variations in document costs vary greatly and are tabulated below for the five systems.

TABLE 6-1

	<u>ORIGINALS</u>	<u>CHANGES</u>	<u>REPRINTS</u>
Present Publishing	\$1,336	\$568	\$1,047
Micropublishing (Optimum)	\$ 737	\$344	\$ 180
Micropublishing (Non-Optimum)	\$1,564	\$693	\$ 278
Surveyed System (Keystroke Input)	\$1,378	\$624	\$ 278
Surveyed System (OCR & Magtape Input)	\$ 671	\$319	\$ 180

Turnaround time for preparation of masters from A/N text should be less than seven days for all the systems considered. Possible limiting factors are graphic merge complexity, pagination and the number of duplicates necessary. An important limiting factor would be the turnaround time of outside vendors that may be used in such phases as duplication.

f. The costing discussion is limited to selected average documents composed of 51% graphics. An increase or decrease in the percentage of graphics will vary costs by directly effecting the A/N input editing and formatting costs, and indirectly by changing systems thruput and use-factors. System thruput is critical in the cost analysis - any factor influencing it up or down will affect document costs.

g. Manpower profiles for all four micropublishing systems analyzed are covered in Appendix E. Costing is based on November 1976 salary levels, and does not include overhead factors - which are used in the overall calculations. A tabulation follows.

TABLE 6-2

	<u>PERSONNEL</u>	<u>YEARLY SALARIES</u>
Micropublishing (Optimum)	40	\$498,750
Micropublishing (Non-Optimum)	40	\$498,750
Surveyed System (Keystroke-Input)	30	\$386,410
Surveyed System (OCR & Magtape Input)	30	\$386,410

CHAPTER 7

MICROPUBLICATIONS USER FIELD TESTING

SECTION I - Introduction

7-1. Purpose. An Army micropublishing system would be of questionable value if its products could not be effectively utilized by the troops in the field. It was necessary that the specific problems associated with the use of micropublications in the Army's operational environment be identified and evaluated during the IMPACT Study. This information was needed both to define production system requirements and to provide a basis for decisions about what to micropublish. A search of the research literature did not reveal any previous studies which dealt with this aspect of micropublishing. The objectives of the user field testing program was to provide information on the user aspects of a micropublishing system.

7-2. General. This chapter describes Project IMPACT's User Field Testing Program activities. Section II describes preliminary actions directed toward test plan development. The test plan as approved by The Adjutant General (TAG) on 7 June 1976, is discussed in Section III. Section IV documents the various aspects of the actual testing. The remaining sections cover the data capture and analysis actions.

SECTION II - Preliminary Activities

7-3. Investigations.

a. Initial activity in the development of the user field testing program identified the publications areas to be included in the user test. The primary criteria for selection were high usage, widespread utilization, and operational importance. The Study of the Army Publication System (STARPUBS) reported that HQDA publications could be broken into three main groups: administrative, doctrinal, and equipment. A study by Grumman Data Systems Corporation (1974) found that equipment publications constituted 81% of the indexed DA publications (forms excluded). However, these reports did not indicate what publications were used most frequently or which were considered to be more important. This information was only available from actual publication users.

b. Several staff visits were made to CONUS installations. These visits accomplished two purposes. First, personnel were interviewed to obtain information about publications usage and reactions to the micro-

publishing concept. Second, each installation was surveyed to determine its suitability as a test site. The installations visited and major units contacted were:

Ft Huachuca, AZ	-	HQ US Army Communications Command
Ft Meade, MD	-	HQ First US Army
Ft Belvoir, VA	-	HQ US Army Computer Systems Command
Ft Campbell, KY	-	101st Airborne Division (Air Assault)
Ft Knox, KY	-	US Army Armor Center, 194th Armored Brigade
Ft Benning, GA	-	US Army Infantry Center, 197th Infantry Brigade

c. The persons interviewed during the staff visits included a wide variety of publications users and some training literature proponents. The overall reaction to the concept of Army micropublishing was positive. However, some areas of concern were expressed:

(1) The supply system may not be able to provide sufficient quantities of good quality microfiche viewers and replacement items (e.g., lamps).

(2) The usage of training literature might decline if it is converted to microfiche.

(3) It might not be practical to put training literature on microfiche because of the large number of viewers that would be needed.

7-4. Preliminary Publications Selections.

a. Army Regulations (ARs) were found to meet all the primary selection criteria: high usage, utilized throughout the Army, and operational importance. Further, many of those interviewed suggested that all ARs be converted to microfiche. However, IMPACT decided on the basis of the information gathered, to use most of the ARs applicable at the company level and similar organizations (the "A" distribution). The exact selection was based on judgment and the needs of the unit(s) participating in the test.

b. Technical Manuals (TMs) do not meet the usage and distribution selection criteria as well as ARs. However, TMs do make-up a large percentage of Army publications and their importance to the operational effectiveness of the Army must be considered. For these reasons, some TMs were included in the user testing program. The selection of particular TMs to be included was based on the requirements of the participants.

7-5. Test Site Selection. All installations visited by IMPACT were surveyed to determine their suitability as test sites. Factors considered in this evaluation were: physical environment, geographic layout, publications usage and needs, willingness to participate, operational demands,

and primary mission. Headquarters, US Army Communications Command, HQ, First US Army, and HQ, US Army Computer Systems Command were rejected because they presented essentially a business office environment staffed by civilians. Data collected under such conditions would not be representative of the Army in the field. The US Army Armor Center and the US Army Infantry Center were excluded for similar reasons. They approximate the operational Army environment only for brief periods of time and their publications' usage is primarily training literature. The 101st Airborne Division was not selected for two reasons. First, testing within a division might have presented problems for test management due to the necessity for staffing requests up to the division command level. Second, there was some concern that the test might interfere with the division's ability to deploy immediately. Either of the separate brigades was acceptable to Project IMPACT. The 194th was found to be unavailable due to other project commitments. The 197th Infantry Brigade at Ft Benning, GA, was selected by FORSCOM to provide field test support (see Appendix M).

SECTION III - Test Plan

7-6. General. The test plan (See Appendix N) briefly summarizes Project IMPACT's activities in the user study area and presents the general test methodology. The Adjutant General's endorsement of the plan constituted the authority for its execution.

7-7. Synopsis. The test plan title, "Field Testing of Micropublications for Usability and Acceptability within Brigade Level Functions" sets forth the scope and purpose of this effort. Three sections comprise the test plan: introduction, user test concept, and user test methodology. The introductory section presents the rationale for the testing program; that is, information on the use of micropublications in the tactical environment is essential to implementation plans and it heretofore has been unavailable. The primary goal of the user field testing program was to provide this information. Section II, user test concept, discusses the test goals and the reasons for using a FORSCOM brigade as the test site. This section breaks the goals into four objectives, and provides an overview of the testing program including scope, resource requirements, and time frame. User Test Methodology, Section III, details the procedures followed in each of the program's four phases. Briefly, the phases were as follows:

Phase I - Baseline Reconnaissance; data collection on brigade operations, structure, and publications usage.

Phase II - Fiche Design Factor Evaluation; determination of microfiche design's influence on usage.

- Phase III - Performance Study; controlled observation study of micropublication usage.
- Phase IV - Field Application Study; determine effect of replacing conventional publications with micropublications.

SECTION IV - TEST EXECUTION

7-8. General. This section describes the execution of the test plan and the preparations required for Phases II-IV. Information gathered during Phase I and constraints encountered during preparatory activities led to a decision to update/revise the test plan. Following a discussion of the update, the test event sequence is presented.

7-9. Preparation.

a. Test Equipment and Supplies Procurement. It was necessary to initiate the procurement of microfiche viewers and storage containers well in advance of other preparations. This meant that decisions concerning types and quantities were made before the test participants had been fully identified. The assumptions on which these were based are:

- Participants would be drawn from a brigade size unit.
- Different functional levels would be studied.
- Both administrative and maintenance areas would be included.
- A variety of viewer types should be examined.
- A sufficient number of viewers must be available to cover all potential participants' requests.
- Viewers should include portable models.
- Microfiche storage containers must be provided.

An evaluation of viewers by manufacturer was not included in the test. Four models were selected on the basis of known performance factors as being representative of the following types: table top, desk top, briefcase and hand-held. The manufacturers, models, and dimensions ordered are shown in Appendix O. Microfiche storage cases were required and an inexpensive case suitable for field carry was selected.

b. Micropublication Preparation.

(1) The decision had been made (see 7-4a) to convert most of the "A" distribution ARs to microfiche for use in Phase IV. Initially, 130 ARs were identified for conversion. This list was to be adjusted to meet specific AR requirements to be determined during Phase I. The size of this conversion required that production start prior to the final selection of the participating units. The Technical Manuals (TMs) to be converted to microfiche could not be identified until the participants' specific needs were determined during Phase I. The TM conversion was thus not initiated until the AR work was essentially completed.

(2) Micro-republishing techniques were used for this conversion effort because of the size of the conversion and the short lead time. Arrangements were made to obtain the use of a high speed step-and-repeat camera located at the Bureau of Census facility in Suitland, Maryland. The exposed film was developed and cut into fiche by the Census Bureau and duplicates were prepared by private contractor. Distribution to users at the test sites was begun on 2 August 1976.

(3) A total of 173 publications (approximately 45,000 pages) were converted to 467 microfiche masters. This total includes both the AR collection and a TM collection; the latter being identified during Phase I activities. In addition to this conversion, special versions of an AR were prepared for Phase II.

c. Specific Test Site and Publication Selections.

(1) Selections of specific test sites and publications to be used in Phase IV could not be made until US Army Forces Command (FORSCOM) confirmed selection of the participating unit (see Appendix M). Phase I of the test was initiated upon notification that the 197th Infantry Brigade, Ft Benning, Georgia, would be the participating unit. The test site and publication selections were finalized during Phase I.

(2) Initial interviews were conducted with the brigade AG and his staff, since the Brigade's Executive Officer had designated the AG as the Test Coordinator. Brigade participation was discussed in detail. Since the previous visit by IMPACT personnel (October 1975), the Company Administration at Battalion Level (CABL) concept had been implemented in the 197th. This meant that all company-level administrative and personnel functions had been consolidated at battalion HQ. The most active users of ARs in a battalion are located in a Personnel Administration Center (PAC). The officers-in-charge (OICs) and the Personnel Staff NCOs (PSNCOs) of all PACs in the brigade were interviewed and briefed on the various aspects of the micropublication user test. IMPACT's tentative decision to issue the "A" distribution ARs on microfiche was discussed, and specific high usage ARs were

identified. On the basis of the information gathered in these interviews, it was decided that a PAC would be well suited for a test site, and three PACs were selected. Since the Brigade AG operations utilize the same ARs as are distributed to the PAC, all Brigade AG divisions were added to the test site group.

(3) All brigade maintenance activities and motor pools were studied and their personnel interviewed. Three activities were selected to serve as test sites. One site performed second echelon electronics maintenance. The others handled track/or wheel maintenance. List of high usage TMs were compiled for each of the sites, and where applicable were prepared on microfiche.

(4) Thus, a total of seven test sites were selected. These sites represented a cross-section of battalion and brigade level functions and types of publications users.

d. Test Site Set-up. The test site set-up procedure was essentially the same for all sites. First, the physical layout of the site was re-examined to determine if there were any special requirements for microfiche viewer installation. Simultaneously, the OIC and the PSNCO were advised of the number and types of viewers to be installed. Second, viewers and microfiche were delivered and set up at the test sites. Third, when all viewers were operational, users were briefed on viewer operations and on microfiche handling procedures. The time required for set-up was variable and dependent on the number of viewers to be installed.

7-10. Constraints.

a. General. During the initial phase of test plan execution several unforeseen problems arose. The nature of these problems precluded the execution of the original test plan. Each major problem area is discussed below; all problems were resolved.

b. Brigade Readiness. While brigade readiness was not an unforeseen problem, it is discussed here for the sake of continuity. The testing program was to be conducted on a non-interference basis; that is, nothing would be done which might impair brigade readiness for redeployment. This precluded the removal of paper publications from the selected test sites. Removal of paper copies of publications converted to microfiche would have been logistically difficult in any case. Further, other researchers have noted that micropublication users can bootleg paper copies despite all attempts by the researcher to prevent it. This situation was minimized by maintaining good rapport with all participants and emphasizing the importance of the test results to the Army's micropublishing efforts.

c. Brigade Operations. Two problem areas are discussed under this constraint category. First, brigade staffing levels and brigade responsibilities to post operations, e.g., housekeeping and guard duty, combined to hold the number of personnel available for Phase II and III testing below originally planned levels. Second, the brigade's daily operations during the test period did not require high levels of AR usage. Although these problems seriously affected the original Phase III concept, they were resolved by test plan modification.

d. Microfiche Viewer Procurement. Project IMPACT identified microfiche viewer requirements for the user field testing program (paragraph 7-9a) and initiated procurement actions for this equipment in advance of the program's anticipated start date. However, delays in purchasing and delivery of equipment necessitated a change in the test plan. This change is discussed in paragraph 7-11. Further, delivery delays were not the same for all pieces of equipment which meant that the microfiche viewer distribution originally planned was disrupted. This problem was overcome by issuing the affected participants one style of viewer at the start of testing and exchanging it for the appropriate style when it arrived.

e. Micropublications Preparation. Micro-republishing was the technique chosen to convert the selected paper copy ARs and TMs to microfiche. However, the produced fiche incorporated a characteristic not usually found in republications: all charts, figures, illustrations, and fold-outs were oriented to the conventional reading position. This characteristic produced an unforeseen lengthening of the conversion effort which delayed the receipt of micropublications by some participants. This problem was resolved by lengthening Phase IV at the affected test sites.

7-11. Test Plan Update.

a. General. A modification of the original test plan was required to meet incurred delays. The most significant change was a rescheduling of the test's last three phases. Several minor changes were also needed.

b. Major Changes. The delay in the receipt of microfiche viewers precluded the original sequential execution of Phase II-IV. This problem was resolved by rescheduling the Fiche Design Factor Evaluation (Phase II) and the Performance Study (Phase III) so that they would occur during the Field Application Study (Phase IV). Test introduction and training was therefore conducted at the beginning of Phase IV.

c. Minor Changes. Other needed changes were made in the plans for Phase II and III. First, manpower require-

ments were reduced to accommodate the personnel availabilities problem. Changes in the experimental designs of these two studies made possible this reduction. Second, Phase I observations indicated that it would not be possible to gather sufficient information, in the time available, to construct the tasks called for in the original plan. However, information look-up, a basic task, was observed to be a common element of most tasks. This basic task replaced the more complex tasks originally planned. A third change was needed as a consequence of the modification just described. The Performance Study, Phase III, became a study of microfiche viewer type's influence on task performance. Fourth, the Microfiche Design Factor Evaluation, Phase II, was limited to a study of the influence of fiche frame arrangements on information retrieval. This change was made in order to free project resources for the conversion effort.

7-12. Event Sequence.

a. General. This paragraph presents the chronology of test plan execution, notes major events, and describes test operations close out. When not at the test site, IMPACT personnel were preparing test materials.

b. Test Execution. The Baseline Reconnaissance (Phase I) was accomplished during the period 6-9 July 1976. Field Application Study (Phase IV) activities commenced on 2 August 1976. Three PACs and the brigade AG user sites had received their viewers and microfiche AR libraries by 6 August 1976. During the period 16-17 August 1976 the sites listed above received additional ARs and TM user sites were put into operation. Further, four additional AR user sites were established at the request of the 197th personnel involved. Three quarter size viewers were delivered to Ft Benning and distributed during the period 31 August to 1 September 1976. A large portion of the maintenance documentation for the M60 and M60A1 tanks was delivered at the same time. Additional user test sites were established: 2/69th Armor PAC and Brigade Maintenance Office. The Fiche Factors Evaluation was administered 15-17 September 1976 and during the period 22-24 September 1976 the Performance Study was conducted.

c. Test Closeout. User Test operations were closed out during the first two weeks of October. Equipment turn-in was accomplished during this period with some exception; some participants expressed a desire to retain their equipment (28%). Those users wishing to retain viewers and micropublications were permitted to do so with the understanding that IMPACT would not provide changes to documents. Appendix P, gives the test equipment status as of 23 October 1976. All equipment not requested by 197th personnel was packed for shipment during the period 20-22 October 1976. A debriefing questionnaire was administered at this time to all users. This questionnaire is discussed as part of Phase IV, the Field Application Study.

SECTION V - DATA COLLECTION AND REDUCTION

7-13. General. This section provides a brief discussion of the relationship between the purpose of each phase and the data collection methods/device used. Micropublication user test data was captured by several means: interviews, observations, fiche design factors evaluation data sheets, production study data sheets, micropublication usage logs, and a debriefing questionnaire. Only the latter item required a significant data reduction effort, i.e., ADP support. A statement of significant findings is given below for each phase.

7-14. Baseline Reconnaissance (Phase I). Interviews and observations were utilized in this phase. Time constraints, personnel availability, and a recognition of the need to build and maintain good rapport with brigade personnel dictated an informal, less structured style of interviewing. All interviews were conducted in work areas. Much of the information gathered dealt with organization, mission, chain of command, operational details, and publications used, needed, wanted, etc. This information was needed in order to make preparations for Phase IV. No attempt was made to examine the area of training literature and only AR and TM usage was studied. The major findings were as follows:

1. Publications usage (exclusive of logistics type publications) is low (on the average, only a few per day within any one area).
2. Publications are used essentially as references.
3. AR libraries are maintained in all battalion (bn) and brigade (bde) administrative/personnel areas.
4. Workload for tasks which could require a publication usage is low.
5. Personnel in Company HQ and Supply areas expressed a need for limited AR libraries.
6. Limited electrical service to shops and offices can pose a problem for microfiche viewer usage.

7-15. Fiche Design Factor Evaluation (Phase II).

a. General. Many characteristics of microfiche used by DOD agencies are fixed by specifications (MIL-M-38748, MIL-M-63048A). However, the layout or arrangement of textual information on the fiche is not fixed. This characteristic appears to be important for two reasons. First, it can influence the speed and cost of operation of

a micropublishing production system by imposing restrictions on the system's input section. Second, the way in which the microfiche is read and possibly the speed at which information is retrieved can be influenced by the information arrangement on the fiche. Three arrangements are possible, and authorities in information science have discussed their use: horizontal, reading left to right; vertical, reading top to bottom; and serpentine, reading left to right on one row, then right to left on the next and so on (see Appendix Q). Several potential micropublications users interviewed by IMPACT expressed opposing views about the suitability of the latter. The purpose of this evaluation was to determine if the speed and accuracy with which Army personnel look up factual information from a micropublication is influenced by the information arrangement on the microfiche. Four hundred thirteen information look up tasks (approximately 137 per arrangement) were completed by brigade personnel. A detailed description of the methodology used is found in Appendix Q.

b. Data Capture. Basic information on each participant's experience with using microfiche was obtained before starting the evaluation. A sample of the data collection sheet filled in with total responses appears in Appendix Q. Most participants (73%) had experience with micropublications usage. Information looked up and time to complete tasks were recorded on a second data sheet. No differences with respect to accuracy were found. Average task completion time was computed for each arrangement. These averages were examined statistically and the differences observed were found to be no better than chance differences (see Appendix Q).

7-16. Performance Study.

a. General. The effect of constraints discussed in paragraphs 7-10d and 7-11c narrowed the scope of this study to an examination of the effect of the type of microfiche viewer used on the performance of information look-up tasks. Information on the relative effectiveness of different microfiche viewer types is essential to the selection of the best viewer for tactical brigade environments. However, effectiveness may not be determined solely by the physical characteristics of the viewer; it may depend in part upon the user's experience with microfiche. The purpose of this study was to determine the relative effectiveness of three different microfiche viewer types while taking into account the users' microfiche experience. A detailed description of the methodology used is found in Appendix R.

b. Data Capture. Basic information on each participant's experience with the use of microfiche was obtained before starting to work on information retrieval tasks. A sample of the data collection sheet and breakdown of the responses obtained are found in Appendix R. Eighteen (18)

of the 28 participants had some experience with microfiche. Each person performed six information retrieval tasks using only one of four available resources: paper copy, desk-top microfiche viewer, briefcase microfiche viewer, or hand-held microfiche viewer. Average time to complete a single task was computed for all participants. The overall difference in performance between experienced and non-experienced persons was examined statistically. The examination showed that the differences were attributable to chance alone. Since there was no meaningful difference between these two groups, individual results were combined within resource groups. Overall measures of information retrieval task performance for each resource group were compared statistically. The paper resource group was found to be significantly faster than any of the microfiche viewer resource groups (Appendix R). No meaningful differences in performance were found when the microfiche viewer resources were compared with one another.

7-17. Field Application Study.

a. General. The purpose of this study was to determine what would happen in the day-to-day operating environment of a FORSCOM brigade when most of the paper copy publications in a functional area were replaced by microfiche copies. Two data capture devices were used: micropublication usage logs (see Appendix S) and a debriefing questionnaire (see Appendix T).

b. Micropublication Usage Logs. Logs were supplied with all microfiche viewers and were available for the entire study period. The importance of maintaining accurate logs was stressed to all participants. However, the limited entries made precluded any conclusive analysis. Further, interviews and observations definitely indicated that log entries did not reflect actual micropublication usage.

c. Debriefing Questionnaire.

(1) This means of data capture was administered to 63 participants after the study period. The results of the questionnaire are reported in Appendix U. Eleven items requested information and did not involve an expression of opinion. The remaining 52 items either asked the participant to report on his experience with or his attitudes/opinions about micropublication usage. In accordance with accepted practices of questionnaire construction several questions were asked in different forms at different locations within the questionnaire. When these questions are compared statistically, the results provide an indication of the respondent's consistency in answering. These comparisons are reported in Appendix V. Comparisons reporting a significance value equal or less than .01 indicate a relationship that could not have occurred by chance alone. Such a result indicates consistency and all tests run indicated this consistency.

(2) The results of several items (six of 63) of particular interest are reported here. A number of items compared micropublications with paper copy publications. Information look-up with micropublications was considered to be faster or at least equal to that of paper copy by 63% of the respondents. Seventy-four percent believed that micropublications were better or equal to paper publications with respect to ease of use. The inability to make notes on the micropublication has been cited as a serious drawback by some authorities in micrographics. However, 54% of the respondents did not find it to be so. Eighty-one percent, reported no difficulty in making the transition from paper copy to micropublications. Eye strain had been reported to be a problem for the use of micropublications, but less than 10% of those answering experienced much of an eye strain problem during reading. Finally, when asked, "would you recommend that additional publications be produced on microfiche?", 82% responded yes.

SECTION VI - Discussion of Test Findings

7-18. General. Phase I and Phase IV findings are discussed together because the results of the former constitute background for the latter's interpretation. The results of Phases II and III were originally intended to be used in Phase IV. However, as indicated in paragraph 7-11 Test Plan Update, the nature of these tests was changed. Although they provide information which can be used in implementation planning, they have no direct bearing on the interpretation of Phase IV.

7-19. Phase I and Phase IV.

a. Phase IV, the Field Application Study, directly addressed the purpose of the field testing program; the determination of the usability and acceptability of micropublications in the tactical environment. The 63 item debriefing questionnaire was the primary data collection device. A full and complete analysis, and discussion of the results obtained (see Appendix U) is well beyond the scope of this chapter. However, certain critical issues are discussed in the following subparagraphs:

- (1) How did micropublication usage compare with conventional paper copy usage?
- (2) What is the effect of micropublication usage on work production?
- (3) Do the users of micropublications favor its implementation by the Army?
- (4) How acceptable are micropublications?

The readers attention is directed to the relevant questionnaire item(s) to permit a detailed examination of the data. Critical findings are reported in the discussion below.

b. Differences in the frequency of publication usage were noted when administrative areas were compared with shop/maintenance areas. Usage must of necessity be higher in the latter than the former. Publications (mainly ARs) are treated as references and are consulted infrequently by administrative users. Shop/maintenance operations on the other hand require an active interaction with publications (mainly TMs). These are the critical findings of Phase I. The usage of micropublications reported in debriefing questionnaire item #5 is probably no different than that of paper copy. This assumption is supported by the responses to item #23. Forty-seven (47) percent of the respondents reported no change in publication usage when micropublications replaced paper copy, 39% indicated that usage increased, and 14% did not respond or reported a decrease. Further, the responses to item #24 provide additional support with 74% reporting little or no change in the way publications are used. The conclusion to be drawn from these observations is that replacing paper copy publications with micropublications is unlikely to degrade publication usage in either the administrative or maintenance areas.

c. Nineteen of the 63 respondents had some experience with microfilm or microfiche prior to the Field Application Study (Phase IV). The others presumably formed their opinions based on their micropublication usage during Phase IV. When asked how micropublication usage had affected their work performance (item #28) 81% responded that it had helped. Further, 84% believed (item #34) that their unit's work production would be improved if micropublications replaced paper copy. These observation suggest that micropublication usage will not degrade work performance. Additional support for this position is found in the results reported in 7-17c(2) above.

d. The majority of respondents saw no problems with micropublishing and were in favor of its implementation in the Army. This conclusion is supported by the response to item #6: 70% of those responding believed that the people they worked with were in favor of using micropublications. An examination of debriefing questionnaire items #41 to 63 provides a similar indication. These items present a series of positive statements about various aspects of micropublishing. A majority agreed with each of these statements.

e. A 100% endorsement of micropublishing was not obtained and was not expected. Resistance to change is a common, widely studied behavioral phenomenon. However, over 71% of those questioned agreed with the statement, "In time, most personnel will prefer micropublications."

7-20. Phase II. The results of the Fiche Design Factor Evaluation (see Appendix Q) suggest that any one of the three information arrangements tested is as efficient/effective as any of the others. This factor would not impose a constraint on the production system. The finding of no difference in information retrieval time between the three arrangements was unexpected. Diametrical opinions about the suitability of the serpentine arrangement had been obtained during Phase I interviews. However, the results obtained may be understandable when the type of task used is considered. The information retrieval tasks used were designed to require a sequential search of the fiche. Look-ups with the different arrangements would require different kinds and types of physical effort. Performance differences would be expected. However, the participants treated the tasks as isolated information look-ups. The conclusion stated above only applies to look-ups. However, Phase I observations and interviews indicated that this was an important task type.

7-21. Phase III.

a. No meaningful difference was found when the performance times of the "experienced" microfiche users were compared with those of the non-experienced group (see Appendix R). Two alternative explanations for this finding are possible. First, the difference between groups may not have been great, since experience with microfiche was limited mainly to that obtained during the Field Application Study. Only 30% of all the participants had any experience prior to the study. Second, previous experience may not have been a critical factor in performance of the tasks used.

b. Information retrieval times were faster using paper copy publications than using micropublications. This is not unexpected since all subjects had more experience with the use of paper copy. However, this apparent advantage of paper copy might not exist if the tasks performed had required the subject to physically retrieve the publication as well as look up the information requested. Further, the Phase I observation (low publication usage and low workload) suggest that the difference obtained may have no practical importance.

c. The failure to find a performance difference between the microfiche viewer types was unexpected. The physical manipulatory problems of hand-held viewer usage were greater than those subjects experienced with the other two.

SECTION VII - Summary and Conclusions

7-22. Summary.

a. General. Project IMPACT conducted its micropublications user field testing program during the period 5 July to 14 October 1976. The purpose was to determine the usability and acceptability of micropublications in the tactical environment and to obtain related information for implementation planning. Participating in the program was the 197th Infantry Brigade at Ft Benning, Georgia. All testing was conducted within their garrison area. The four program phases, Baseline Reconnaissance (I), Fiche Design Factor Evaluation (II), Performance Study (III), and Field Application Study (IV), and their results are summarized below in relation to the purpose.

b. Usability and Acceptability. Phases I and IV are directly applicable to the first portion of the purpose stated above. Following is a brief description of testing procedures and a summary of the results.

(1) Testing Procedures. Brigade publication usage, organization, and physical conditions were examined by observation and interview during Phase I in preparation for Phase IV. Microfiche equivalents of conventional publications were issued to 11 users groups. Seven groups in administrative/personnel areas received ARs and TMs were supplied to four shop/maintenance activities. All but one of the former used micropublications for approximately 8 weeks and the latter had a minimum of 6 weeks usage. A debriefing questionnaire was administered to all available participants at the conclusion of Phase IV.

(2) Results. The manner and frequency of publication usage noted in Phase I did not change appreciably when micropublications were used, according to the questionnaire data. Work production was not degraded by micropublication usage and some respondents believed that production improved. Overall, no significant problems were identified. Checks built-in the questionnaire indicated that the respondents answered in a consistent manner indicating reliable results.

c. Planning Information. Phases II and III were conducted to clarify issues relevant to implementation planning. Both were short term psychological experiments and were carried out during the latter part of Phase IV. Issues and results are stated for each phase.

(1) Phase II, Fiche Design Factor Evaluation. Could the manner in which textual information is arranged on a microfiche influence the speed and accuracy of information retrieval? No meaningful differences were found between the three designs tested when the task studied was of a short, factual information look-up. This type of task is commonly encountered in daily operations.

(2) Phase III, Performance Study. Two potential influences on information retrieval performance were examined. These influences were the subjects' microfiche experience and the type of microfiche viewer used. No meaningful differences in performance times were found when experienced and non-experienced subjects were compared. Similarly, the type of microfiche viewer used did not produce meaningful performance differences.

7-23. Conclusions.

a. Micropublications, ARs and TMs, were accepted and used as if they were paper copy publications. However, the soldiers who used micropublications were of the opinion that they are superior to paper copy. A clear majority of those participating in the micropublication user field testing would favor the implementation of micropublishing in the Army.

b. The results of IMPACT's field test revealed no problem which would prevent the implementation of micropublishing for administrative/personnel areas or shop/maintenance areas. Little introductory training was needed. The micropublications users reported that the transition from paper copy was easy. Special microfiche viewers are not needed. Good quality off-the-shelf viewers were readily accepted. Further, the use of micropublications under actual field conditions was not seen as a problem.

c. Three events occurred during the Field Application Study phase which highlight these conclusions. A Staff Sergeant, preparing to depart on PCS from the brigade, made arrangements to purchase a briefcase type microfiche viewer with his own funds. He wanted the viewer so that he could take an AR library to his next duty station. Another event involved an armor battalion maintenance officer. He elected to take a tank maintenance library on microfiche to the field to prepare for an off-post exercise. This was made possible through the use of a briefcase type microfiche viewer adapted for a tank's power supply. Third, at the conclusion of the study the participants asked to retain 44% of their equipment even though IMPACT could no longer provide updates to microfilmed documents.

CHAPTER 8

PROPOSED MICROPUBLISHING SYSTEM

8-1. General.

a. Consolidation of analyses from the foregoing chapters has defined a "best choice" for a proposed HQDA micropublishing installation. This chapter formulates the detailed specifications of that system configuration, its component equipment, and the supporting personnel complement. Using methodology similar to the project's CBA (Appendix E), several size levels of this system can be predicted based on production limits.

b. Results from a DACA-CAF report on methodology concurrence and IGAA-ECO audit of the CBA and proposed micropublishing system are included as Appendix W. Exceptions noted by AAA have been incorporated in the calculations that follow and in the CBA, as have changes due to an updated version of personnel requirements.

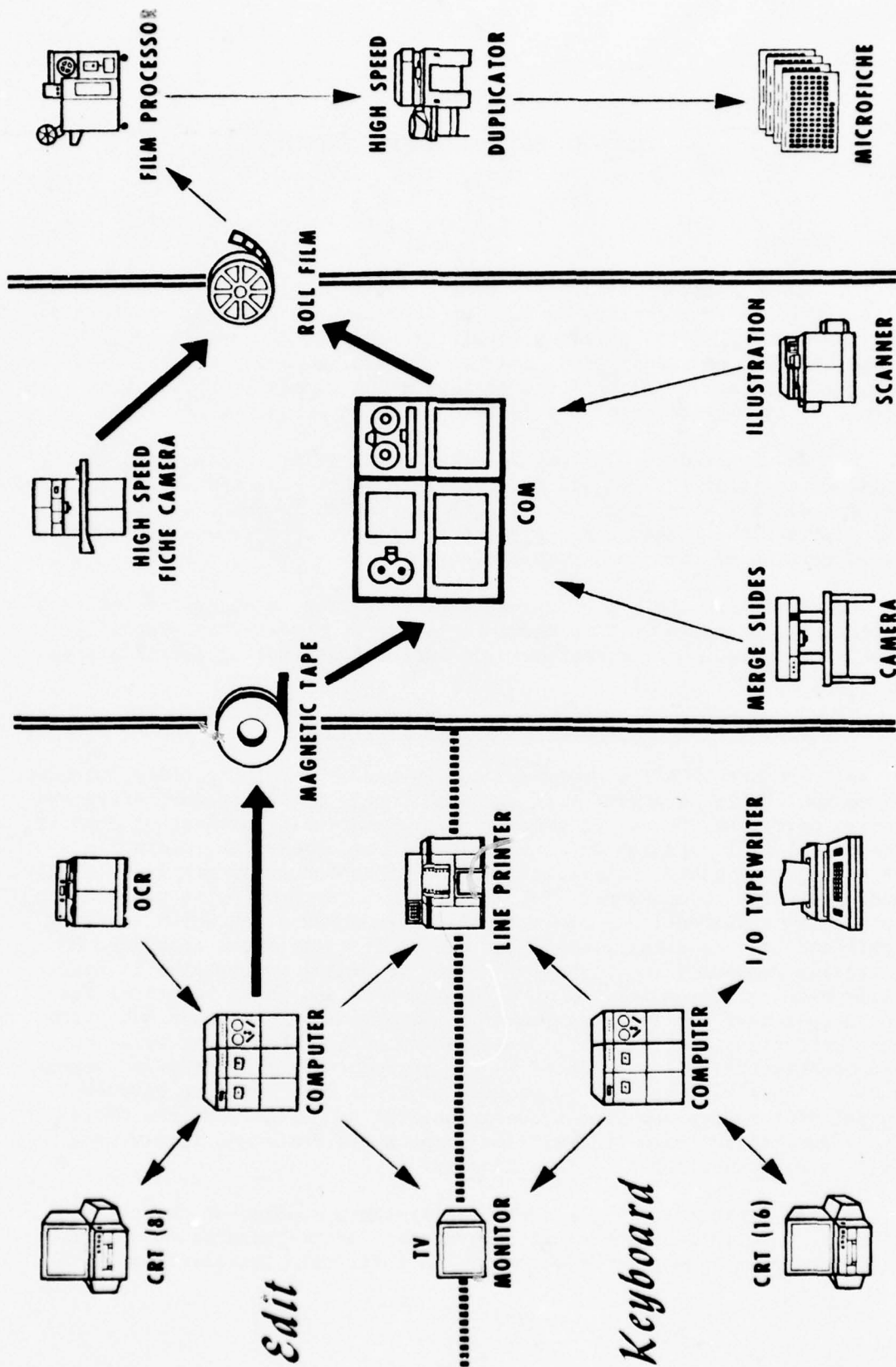
c. Following the system proposal presentation, a suggested implementation plan/schedule will be chronologically defined. This plan will discuss specific major milestones and will not attempt to detail a step-by-step "process".

8-2. Proposed HQDA Micropublishing Installation.

a. Project IMPACT's prototype design concept was originally intended to be applicable to a real-life micropublishing installation. After six months operation the design concept remains basically unchanged; that is, the tri-modular approach which separates input/conversion, microfilm - recording, and master microfilm development/reproduction are functionally and physically independent. The conversion subsystem, print preparation, remains as a shared-logic mini-computer driven operation which converts digitized text to print format that can be directly input into the COM microfilm recording subsystem. This COM recording system also is basically unchanged from its prototype predecessor and in an identical fashion merges text and illustrations for microfilming. The last subsystem, development/duplication, will be performed both in-house and by an outside contractor. An innovation is the introduction of a step-and-repeat camera. This will be used to provide reprints from existing hardcopy. Output of the step-and-repeat operation will go directly to the microfiche duplication main system. The comparative costs and involvement will be discussed later in this chapter.

b. As depicted in Figure 8-1, the system's configuration will continue to have three independent subsystems: print-preparation, microfilm recording, and film development. A full scale installation which

PROPOSED MICROPUBLISHING SYSTEM



can handle approximately 2,100 average size 75 page original publications per year, requires 25 input stations to convert proponent input to magnetic media in preparation for COM recording. Inputs through the OCR are 20% of the 1,750 documents that can be keystroked. Throughput of the step-and-repeat camera is set at 2,000 documents/year, considerably below the maximum output of the camera.

c. As depicted in Figure 8-1, the 25 stations can be functionally subdivided into 17 text input stations and eight edit/print formatting stations. Text input is the entry of alphanumerics with a minimum of instructions for page formatting. It may include commands for paragraphs and general heading structures. The eight edit/print stations are principally dedicated to the insertion of printing commands after the text has been placed onto mag-media by the text entry stations. These commands include definition of font styles, line and letter spacings, right and left justifications, hyphenations, and commands for illustration insertions. The edit/print stations may be used bi-modally for both edit/print and text input. For the large system considered the main reason for the text entry sub-component and its own dedicated CPU is to allow for large amount of keystroke data entry without overloading the main (edit/print) CPU. Conceptually this allows the alternative of starting up with only the edit/print subsystem, using it bi-modally, and adding the text entry system in discrete portions as the entire micropublishing system is brought up into full production. It is anticipated that the components of the text entry unit will be acquired on a lease basis. It is also anticipated that this acquisition will be made only after the edit/print unit is saturated, and that it will be sized by examining the anticipated needs for future re-keyboarding (data capture).

d. The text entry (I/O) devices, as shown, consists of 15 CRTs, a typewriter, and an OCR device. Original hardcopy or alphanumeric text changes to current publications text is first entered by the text I/O station onto disk files which can then be accessed by the edit/print I/Os to complete the print formatting. The OCR device will be hardwired to the CPUs but will have its own mini-computer (that is, it will not be "slaved" to the subsystem's CPUs as was the prototype). As in the prototype operation digital data entry, if available, can be entered directly into either of the two main CPUs, thus considerably cutting down on the necessity of keystroke entry. Reformatting of "stranger" tapes can be done either by the host CPU or off-line on another system. In order to have hardcopy print outs for editing from the CRT stations an on-line hi-speed printer (without font changes or print spacings) will be hardwired through the main CPUs and accessible to all I/O terminals. In addition, I/O operators will be able to visually inspect actual final printout with the entire range of print variations on a 23 inch Video Display Screen also activated by inquiry from an I/O station.

e. The end product of the print preparation subsystem is a 9-track tape with all information needed to drive the COM subsystem. When required, software programs can be used to change the output tape so that it can be used to drive photocomposition devices.

f. The interface between the print preparation subsystem and the COM recording subsystem can be either through a tape drive or by direct hardwiring of the edit/print module to the COM's CPU. The proposed system will make use of a tape drive as input, but it can be retrofitted for the hardwire connection, if and as needed. The proposed COM recording subsystem will be identical with the prototype's design except for camera definition. The HQDA micropublishing system may be required to produce 48:1 as well as 24:1 microfiche, therefore, a separate 48:1 camera will be added to the system to provide maximum versatility.

g. The development of COM produced master microfiche film will be accomplished in-house using a full-reversal processing system. The operations will require hot/cold filtered water supply sources and drain facilities for waste solutions. The production and distribution of quantity duplicates is an area which, although more economically produced in-house, may be best done in the private sector.

h. The step-and-repeat camera being considered is a high speed micro-filming system that automatically microfilms one or both sides of documents on 105mm film. Factory installed innovations make it possible to handle right reading pages, flexible titling and indexing. Both 24:1 and 48:1 reduction ratios are possible thru lens substitution.

i. One consideration which surfaced during prototype operation is the production of the illustration merge slide for insertion during micro-filming. This operation will be performed in-house until the private sector develops the needed expertise and can match in-house per item costs.

j. Project IMPACT's prototype had planned in its schedule to accelerate its keystroke input operations by obtaining COM-ready conversion tapes through a contract service. These products never materialized due to the inability of contractors to develop software compatible with the IMPACT COM subsystem. This possibility will be investigated further during implementation.

k. The detailed listing of all the proposed system equipment purchase costs and yearly supply and personnel expense are listed below. Cost centers follow the format used in the CBA except that duplication is performed by outside contractors at \$.08/copy. A costing analysis for the step-and-repeat operation is included. Total personnel requirements are presented initially and then broken down between the cost centers. The cost centers are print preparation, film recording, developing, merge slide preparation and step-and-repeat operations. Each cost center is further subdivided into equipment and maintenance, associated personnel, overhead and supplies. Equipment and maintenance is specified both as a purchase cost and as a yearly lease and maintenance cost. All other costs are defined in \$/year.

(1) Total Personnel Requirements.

<u>TITLE</u>	<u>NO</u>	<u>GRADE</u>	<u>SALARIES/YEAR</u>
Division Chief	1	14.5	\$ 32,557
Management Analyst	1	12.5	23,166
Management Analyst	1	11.5	19,332
Operations Research Analyst	1	12.5	23,166
Psychologist	1	12.5	23,166
Computer Specialist	2	12.5	46,332
Computer Specialist	1	9.5	15,977
Supervisory Photographic Tech	1	12.5	23,166
Secretary	1	7.5	13,059
Micrographics Technologist	1	7.5	13,059
Editorial Assistant	1	9.5	15,977
Editorial Assistant	3	6.5	35,262
Editorial Assistant	4	5.5	42,172
Clerk Typist	2	5.5	21,086
Clerk Typist	2	4.5	18,848
Clerk Typist	11	3.5	92,358
Clerk	2		16,792
TOTAL	36		\$475,475

The division chief, grade 12.5 management analyst, operation research analyst, psychologist and secretary are considered managerial and supervisory. The computer specialists, grade 11.5 management analyst and supervisory photographic technician are considered operational and training.

(2) Print Preparation.

(a) Equipment and Maintenance.

Input System:

Edit package includes, disk drive, CPU	
4 Input Stations and Software	\$69,500
12 additional input stations @\$2,900	34,800

Composition System:

CPU	45,000
Drive and Controller	30,000
Magtape 800/1600 BPI	20,000
Line Printer	20,000
8 Edit Stations @\$6,000	48,000
Composition Software	18,000
Graphics Display Terminal	30,000

Intellegent OCR	\$ 44,000
OCR Interface Hardware and Software	15,000
Film Recorder Interface Hardware and Software	30,000

Additional Software:

Page Makeup	15,000
Book Pagination	15,000
TOTAL	<u>\$434,300</u>

Lease Plus Maintenance	\$171,983/year
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(b). Personnel.

<u>1.</u> Managerial and supervisory (1/3)	\$ 38,371/year
<u>2.</u> Operational and Training (1/3)	34,936
<u>3.</u> Editorial Assistants and Clerk Typists	225,703
<u>4.</u> Total	\$299,010/year

(c) Overhead.

<u>1.</u> Assigned to personnel at 30.6%	\$ 91,497/year
<u>2.</u> Non-personnel	9,707
<u>3.</u> Total	\$101,204/year

(d) Supplies.

<u>1.</u> Archival Tapes at \$8.40/unit	\$ 17,640/year
<u>2.</u> Miscellaneous	1,000
<u>3.</u> Total	18,640/year

(e) Grand Total	\$590,837/year
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(3) Film Recording.

(a) Equipment and Maintenance.

Basic Film Recording System with:	
Teletypewriter and 9-track MTU	\$195,000
CRT Monitor	6,250
8K Memory Ext (2) @\$8,000	16,000
Disk Drive	36,000
Optical Merge	38,500
High Speed Graphic Arts Generator	27,500

High Speed Thruput Feature	\$ 22,500
Line Draw Features	26,250
Microfilm Camera (24:1, 42:1)	28,500
Microfilm Camera (48:1)	31,500
Conversion Kit	2,650
2 Extra Magazines (105mm)	2,400
1 Extra Magazine (16mm)	<u>690</u>
TOTAL	\$433,740
Lease Plus Maintenance	\$171,761/year
(b) Personnel.	
1. Managerial and Supervisory (1/3)	\$ 38,371/year
2. Operational and Training (1/3)	34,936
3. Total	73,307/year
(c) Overhead.	
1. Assigned to personnel at 30.6%	\$ 22,432/year
2. Non-personnel	9,707
3. Total	\$ 32,139/year
(d) Supplies.	
Miscellaneous	1,000
(e) Grand Total	\$278,207/year
(4) Developing.	
(a) Equipment and Maintenance.	
1. Master Developer System	\$ 8,548
2. Silver Duplicate Developer System	8,308
3. Total	16,856
4. Lease plus maintenance	6,675/year
(b) Personnel.	
1. Photographic Technician (1/2)	\$ 6,529
2. Clerk (1/2)	4,198

<u>3.</u> Total	\$ 10,727/year
(c) Overhead.	
<u>1.</u> Assigned to personnel @30.6%	\$ 3,282/year
<u>2.</u> Non-personnel	3,236
<u>3.</u> Total	\$ 6,518/year
(d) Supplies.	
<u>1.</u> Film at 43.69/roll	\$ 4,377/year
<u>2.</u> Developing Chemicals:	
Developer (150 gallons)	\$777
Fixer (150 gallons)	\$ 1,259
<u>3.</u> Miscellaneous	333
<u>4.</u> Total	\$ 6,746/year
(e) Grand Total	\$ 30,666/year
(5) Merge Slide Preparation.	
(a) Equipment and Maintenance.	
Merge Slide Positioning Camera with Auxiliary Equipment (2 units) Lease Plus Maintenance	\$ 15,600 6,178/year
(b) Personnel.	
<u>1.</u> Management and Supervisory (1/6)	\$ 19,186/year
<u>2.</u> Operational and Training (1/6)	17,468
<u>3.</u> 1 Clerk	8,396
<u>4.</u> Total	\$ 45,050/year
(c) Overhead.	
<u>1.</u> Assigned to personnel at 30.6%	\$ 13,785/year
<u>2.</u> Non-personnel	3,236
<u>3.</u> Total	\$ 17,021/year

(d) Supplies.

<u>1.</u> Photoplast slides	\$211,680/year
<u>2.</u> Miscellaneous	333
<u>3.</u> Total	\$212,013/year

(e) Grand Total \$280,262/year

(6) Step and Repeat Operation.

(a) Equipment and Maintenance.

<u>1.</u> Camera	\$ 71,316
<u>2.</u> Lease plus maintenance	28,241/year

(b) Personnel.

<u>1.</u> Management and Supervisory (1/6)	\$ 19,186/year
<u>2.</u> Operational and Training (1/6)	17,468
<u>3.</u> Photographic Technician (1/2)	6,529
<u>4.</u> Clerk (1/2)	4,198
<u>5.</u> Total	\$ 47,381/year

(c) Overhead.

<u>1.</u> Assigned to personnel at 30.6%	\$ 14,499/year
<u>2.</u> Non-personnel	3,236
<u>3.</u> Total	\$ 17,735/year

(d) Supplies.

<u>1.</u> Miscellaneous	\$ 333/year
<u>2.</u> Additional stationary type	1,000
<u>3.</u> Total	\$ 1,333/year

(e) Grand Total \$ 94,690/year

l. It is possible to degrade this system by reducing the number of I/O stations. The degraded system is capable of producing 1,400 documents/year through the COM unit and also a thruput of 2,000/documents per year through the step-and-repeat module. The step-and-repeat process is not downgraded. As a last example, a pilot system handling 700 and 2,000 documents/year respectively is considered.

m. Table 8-1 presents a condensed general view of the analysis of the proposed full system. It also includes the results of a degraded and pilot system analysis. The methodology used for the above are identical to that used for the proposed full system but the results are presented only in tabular form for brevity.

TABLE 8-1

		<u>25 ENTRY</u> <u>STATIONS</u>	<u>17 ENTRY</u> <u>STATIONS</u>	<u>9 ENTRY</u> <u>STATIONS</u>
Thruput (COM)	documents	2,100	1,400	700
Thruput (Step-and-Repeat)		2,000	2,000	2,000
Print Preparation				
Equipment & Maintenance	\$/year	\$171,983	\$160,340	\$147,470
Personnel		299,010	215,243	132,943
Overhead		101,204	75,571	50,387
Supplies		18,640	12,760	6,880
TOTAL		<u>\$590,837</u>	<u>\$463,914</u>	<u>\$337,680</u>
Film Recording				
Equipment & Maintenance	\$/year	\$171,761	\$171,761	\$171,761
Personnel		73,307	59,139	53,815
Overhead		32,139	27,804	26,174
Supplies		1,000	1,000	1,000
TOTAL		<u>\$278,207</u>	<u>\$259,704</u>	<u>\$252,750</u>
Developing				
Equipment & Maintenance	\$/year	\$ 6,675	\$ 6,675	\$ 6,675
Personnel		10,727	4,198	4,198
Overhead		6,518	4,520	4,520
Supplies		6,746	5,320	3,845
TOTAL		<u>\$ 30,666</u>	<u>\$ 20,713</u>	<u>\$ 19,238</u>
Merge Slide				
Equipment & Maintenance	\$/year	\$ 6,178	\$ 6,178	\$ 3,089
Personnel		45,050	37,967	35,304
Overhead		17,021	14,854	14,039
Supplies		212,013	141,453	70,893
TOTAL		<u>\$280,262</u>	<u>\$200,452</u>	<u>\$123,325</u>

TABLE 8-1 (Continued)

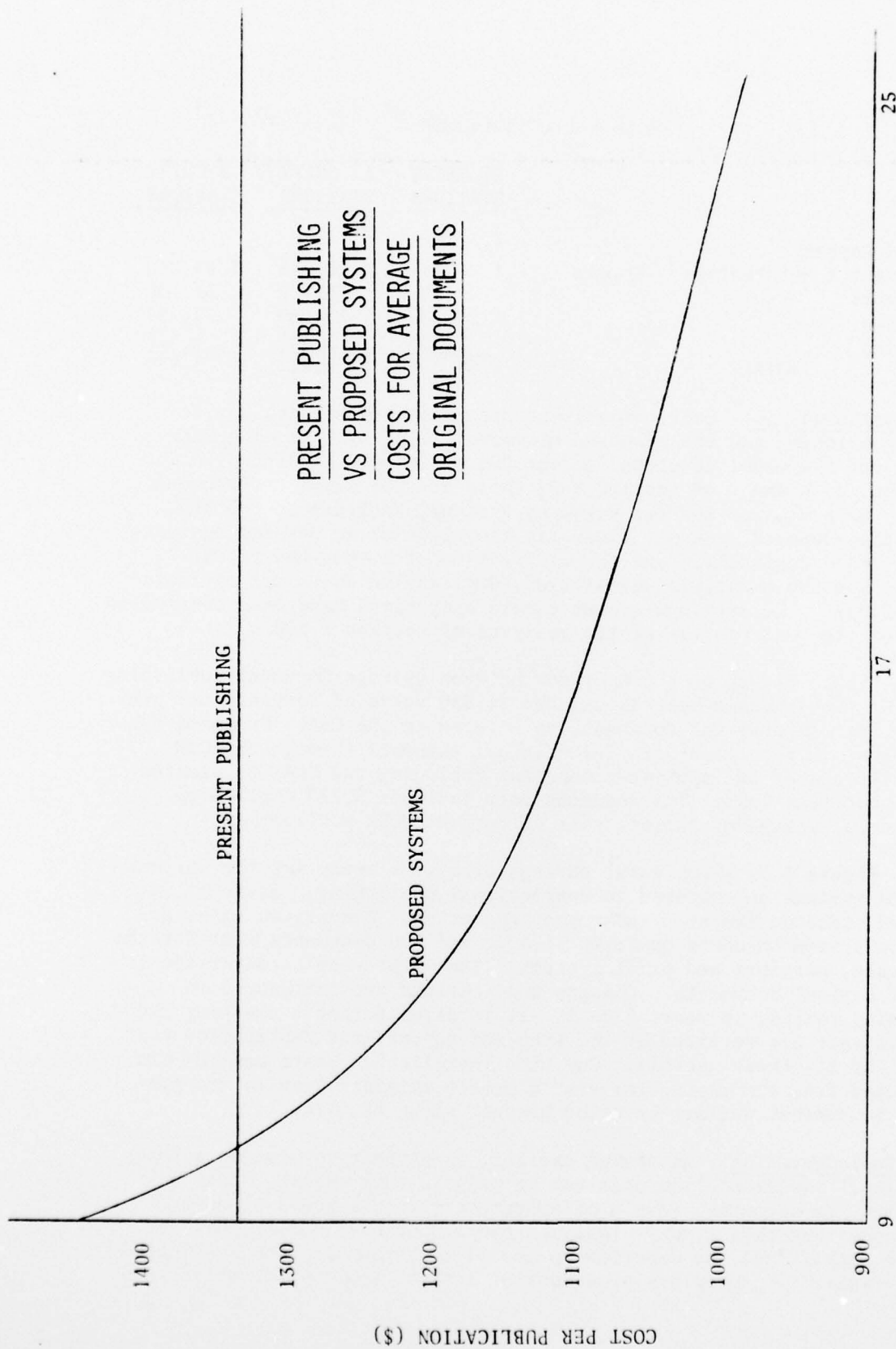
		25 ENTRY STATIONS	17 ENTRY STATIONS	9 ENTRY STATIONS
Step-and-Repeat				
Equipment & Maintenance	\$/year	\$ 28,241	\$ 28,241	\$ 28,241
Personnel		47,381	33,769	31,106
Overhead		17,735	13,569	12,754
Supplies		1,333	1,333	1,333
TOTAL		\$ 94,690	\$ 76,912	\$ 73,434

8-3. Cost Analysis. Cost comparisons are presented between conventional publishing and the proposed micropublishing system. The methodology and the model developed in the CBA are used. As discussed in paragraphs a, h and k of section 8-2, there are two major differences between the prototype and the surveyed systems, analyzed in the CBA, and in the proposed system. These are the usage of an outside contractor for diazo duplication and the utilization of a step-and-repeat camera. For the quantities considered, duplication costs are estimated at \$.08/copy. The step-and-repeat camera operations have been considered as one of the cost centers of the analyses of section k and m.

a. Figure 8-2 shows a comparison between average document publishing costs for the proposed systems and the \$1,336 value of conventional publishing, for an original document, as covered in the CBA. Proposed systems costs, in this case, are for original thruputs through the COM unit. The number of input stations (not including the OCR) is plotted against document cost. The document cost includes 5,237 duplicates, selected as average by the analysis of current HQDA publication.

b. Figure 8-3, shows total savings over five years for the various proposed systems as compared to conventional publishing. Savings, as depicted, include the step-and-repeat operation. Conversion rates are based on system thruputs of 2,100, 1,400, and 700 documents/year for the full scale, marginal and pilot systems. The first year's conversion is only of original documents. Changes and reprints are introduced in increasing ratios, in years 2 to 5. It is assumed that a constant 2,000 reprints/year are serviced by the step-and-repeat, and duplication cost centers of all these systems. One time installation costs and TDY are subtracted from the particular year's profit margin. Results are presented in current dollars by using present value factors.

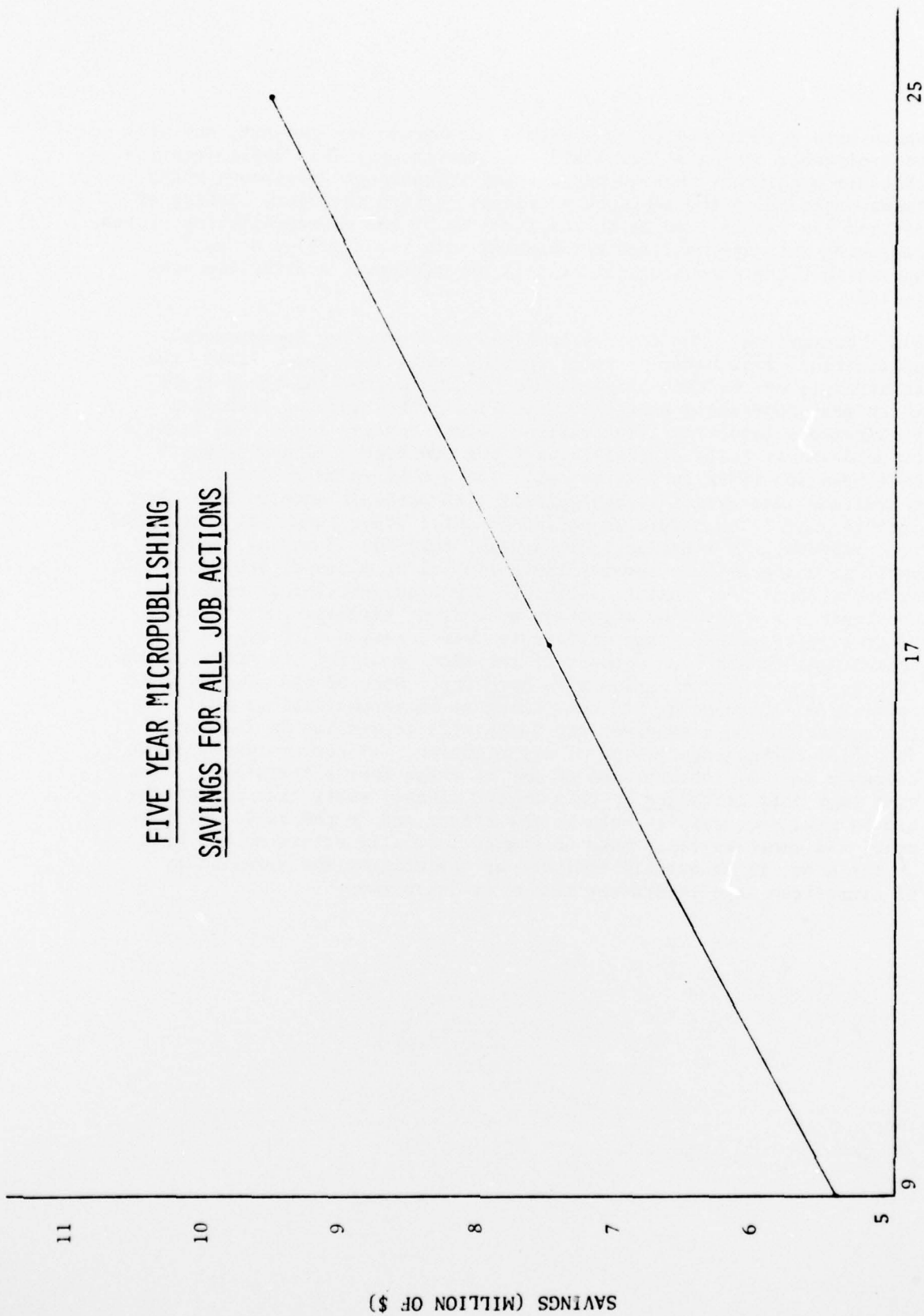
8-4. Implementation. As stated earlier, no attempt to produce a fully operational implementation plan can be made in this report. Such a plan with its necessary levels of operational detail would be more voluminous than this study. Implicit throughout this report, however, are the details and the experiences needed to construct such a detailed plan. Figure 8-4, provides a sequential list of those major milestones



NUMBER OF ENTRY STATIONS

Figure 8-2

FIVE YEAR MICROPUBLISHING
SAVINGS FOR ALL JOB ACTIONS



NUMBER OF ENTRY STATIONS
Figure 8-3

which have been uncovered and learned throughout the project, and will be applicable during a full-scale implementation. This implementation schedule highlights those dependent and independent milestones which, taken together in the sequence provided, furnish the macro listing of actions and events leading to the start up of the micropublishing system. Beginning with approval and terminating with the start up of full operations, the chronological list is arranged over a fifty-two week period.

8-5. Conversion. The choices involved in converting Departmental publications from hardcopy to microfiche media are many. First, the constraints of the technology should be considered, and those areas which are constrained should be dispelled. The range of technical requirements involving illustrations, right-reading pages, and inserts or foldouts is fully compatible with the COM based techniques which have been described in this report. The use of color in the finished microfiche also exists technologically, however, it appears that the inclusion of color should be postponed until other technical techniques are mastered. In retrospect, it appears that few if any of today's publications are truly outside the potential of micropublishing in an operational environment. Although the micropublishing technical constraints are few, the magnitude of current hardcopy publication usage requires careful and deliberate consideration with regard to selecting the method or methods of introducing microfiche publications in lieu of or in combination with hardcopy. Some of the obvious procedures for introducing and converting to micropublications are: (1) conversion on a geographical basis, (2) conversion by functional area, (3) conversion by type of organization, (4) conversion by major commands and (5) combinations of any of these four alternatives. The user test data contained in this report clearly state that microfiche can be used successfully both in the office and in the field environment, and wherever resistance to change initially exists in the mind of the user, it is quickly replaced by the utility and versatility of microfiche once this newer medium is introduced.

PROPOSED IMPLEMENTATION SCHEDULE

WEEKS

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

1 TAG APPROVAL **

1 / FUNDING CONCURRENCE (2 WKS) **

2 / SUBMIT MICRODIS FOR APPROVAL (4 WKS) **

3 / SELECT IMPLEMENTATION GROUP (9 WKS)

4 / DEFINE SITE REQUIREMENT (5 WKS)

5 / PROCESS JCP APPROVAL (8 WKS) **

6 / WRITE POSITION DESCRIPTIONS (7 WKS)

7 / CONFIRM SITE LOCATION (5 WKS)

8 / PRELIMINARY CONTRACTS ACTIONS (8 WKS)

9 / BRIEF DA STAFF AND MACOM'S AS REQUIRED (5 WKS)

10 / ISSUE DA CIRCULAR (7 WKS)

11 CONTRACT PLACEMENT PROCEDURES (15 WKS) **

12 SELECT OPERATING PERSONNEL (15 WKS)

13 FORMALIZE OPERATING PROCEDURES (13 WKS)

Figure 8-4a
115

PROPOSED IMPLEMENTATION SCHEDULE

WEEKS

27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52

11 / CONTRACT PLACEMENT PROCEDURES (15 WKS)**

12 / SELECT OPERATING PERSONNEL (15 WKS)

13 / FORMALIZE OPERATING PROCEDURES (13 WKS)

14 / SCHEDULE CONTRACT SERVICES (8 WKS)

15 / INSTALLATION PREPARATION (10 WKS)

16 / EQUIPMENT INSTALLATION (6 WKS)**

17 / EQUIPMENT ACCEPTANCE TESTS (4 WKS)

18 / DEBUG MODULES (4 WKS)

19 / PERSONNEL TRAINING (25 WKS)

20 / SUPPLY ACQUISITION (23 WKS)

21 BEGIN STEP-AND-REPEAT OPERATION (15 WKS)

22 / DEBUG SYSTEM (4 WKS)

23 BEGIN COM OPERATION (2 WKS)

** INDICATE CRITICAL MILESTONE COMPLETION DATES

Figure 8-4b

CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS

9-1. General. The conclusions presented are consolidations of the various findings of the foregoing Chapters 2 through 7. For the purpose of discussion they are separated into two categories: Micropublishing (performance, equipment and systems); and microfiche usage (user attitudes and media usability). The elemental level of conclusions has been covered in detail throughout the previous chapters, therefore, this chapter will address conclusions by specific descriptions within general applications to HQDA micropublishing. Recommendations are a further consolidation and refinement of the concluded positions to present firm suggestions for the future directions of the HQDA micropublishing efforts.

9-2. Conclusions.a. Micropublishing.

(1) Micropublishing as a replacement for or as an adjunct to hardcopy publishing has shown significant cost savings in production, storage, and distribution. It has also proven to have a faster turnaround time for returning changed publications to the field.

(2) COM-based micropublishing systems are the current state-of-the-art. Although this application to true printing has few proponents at this date it is being rapidly accepted as the upcoming direction of the technology.

(3) COM microfilming equipment has a high initial cost investment because of its computer based design. The high initial cost can be quickly recovered. This was substantiated in the project's cost analysis comparing conventional publishing to a proposed COM-based full scale (25 input station) system, which indicated a projected \$9.5 million savings over five years.

(4) COM micropublishing designs can meet the two mandatory HQDA publishing requirements of merging text with illustrations, and rapid turnaround time from the initial job requests to user distribution.

(5) In-house COM micropublishing has a significantly higher cost saving than through contract services. This is particularly evident

in the production of duplicate microfiche. Contract services to perform micropublishing through COM-based systems which meet the DA publishing scope are not a standard available service.

(6) Tri-modular micropublishing designs are the best approach to equipment selection. Independently operated devices for the three functions: print preparation, film recording, and master fiche film development/duplication permit a maximum flexibility for system operation, emergency actions, and technological upgrading.

(7) Micropublishing can accept the total range of HQDA publications from total text, AR types, to those with extensive illustration content, TM types. New publications and those job requests with significant changes to original text are the most economically advantageous candidates for conversion to microfiche.

(8) Micropublishing personnel for operation of a printing COM application are not readily available and must be trained on-the-job. The use of ADP oriented persons has shown the greatest results in speed of learning and quality of individual work efforts.

(9) In many cases, conversion from hardcopy to microfiche will require documents to remain in hardcopy form, as well as, in microfiche.

(10) In a tri-modular system design an extremely sensitive area is the software interface between mini-computer systems and requires a careful definition of the manufacturer's responsibility for performance.

b. Microfiche Usage.

(1) The use of microforms in general and microfiche in particular has received only isolated opposition to hardcopy conversion of either administrative or technical publications at all DA personnel levels.

(2) The present quality level of microfiche readers can meet the requirements of most DA personnel. The design of improved hand held devices will gain the acceptance of microfiche by the individual soldier.

(3) The number of viewers in the DA are not presently sufficient in placement or numbers to meet a full conversion of hardcopy publications to microfiche. Complete and detailed records of the quantity and location of viewers/viewers-printers throughout the Army is unavailable (records based on current distribution of microfiche indicates an estimate between 13,000 and 30,000).

(4) The use of microfiche is acceptable from the HQ level to usage inside vehicles which have an electrical power source.

9-3. Recommendations.

a. That a detailed follow-on study (IMPACT II) be initiated to establish the elements required to affect an optimal conversion to micropublications.

b. That the IMPACT Final Report be approved.

c. Upon the revalidation of IMPACT's findings by IMPACT II the following recommendations be considered:

(1) That a COM-based, in-house operated, contractor supported micropublishing installation be created.

(2) That micropublishing be organized as a division of the TAG Publications Directorate (DAAG-PAZ).